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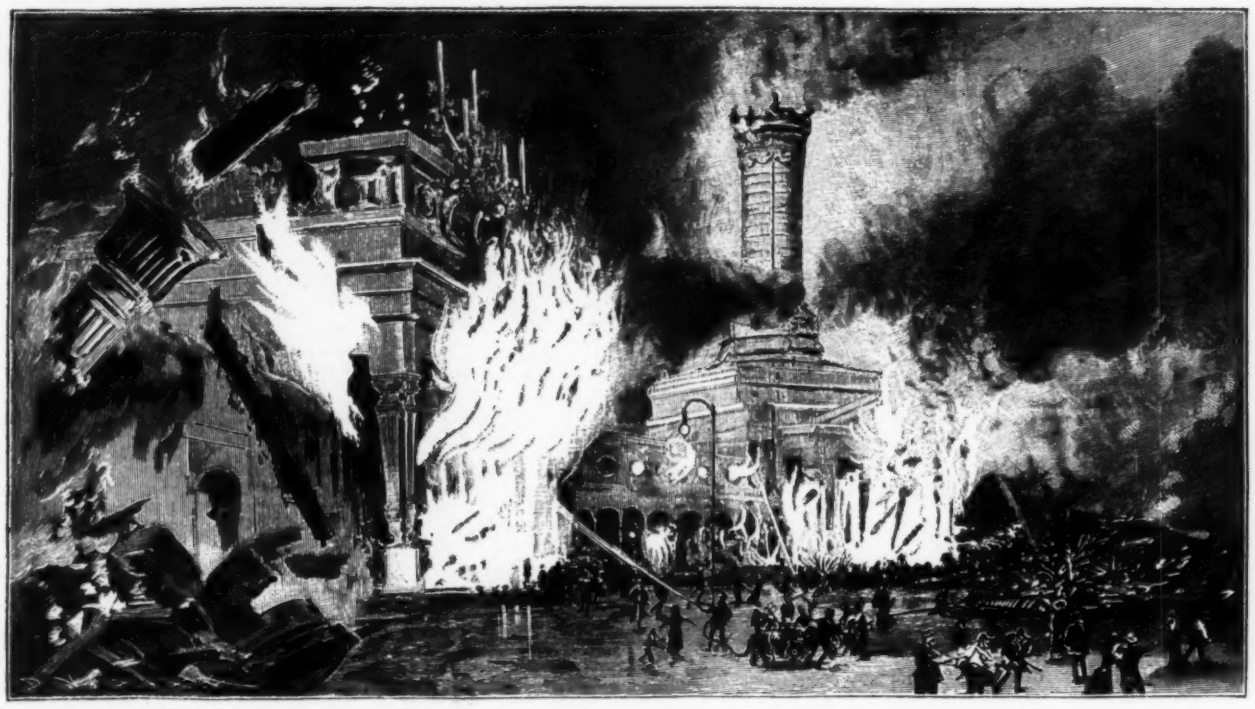
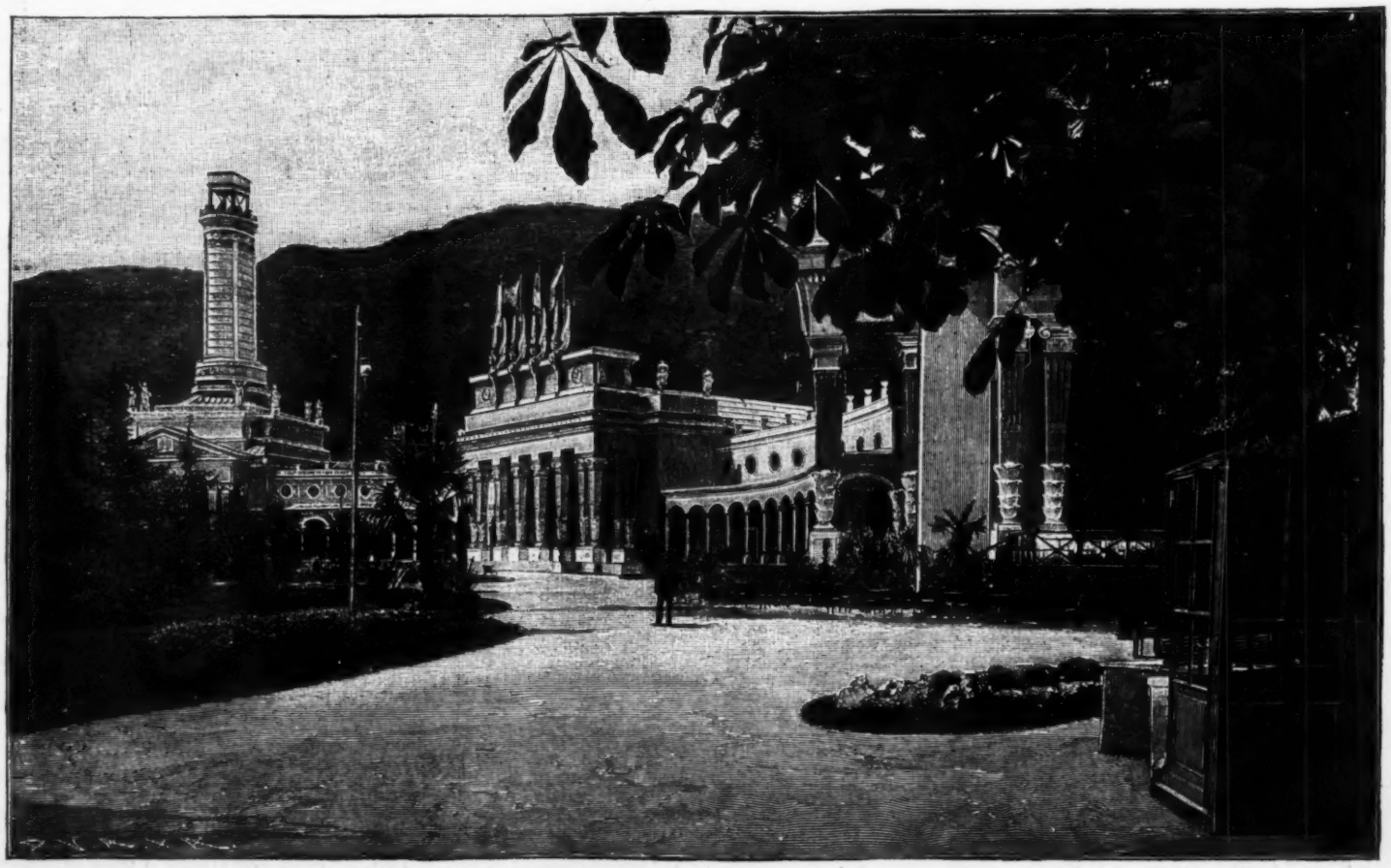


THE BURNING OF THE COMO EXPOSITION BUILDINGS.



A PART OF THE EXPOSITION BEFORE THE FIRE.

THE DESTRUCTION OF THE EXHIBITION BUILDINGS AT COMO.

THE buildings of the exposition held in honor of Volta were burnt to the ground on the morning of July 8. Of the origin of the fire, several eye-witnesses have given accounts which agree in the main.

At the junction of the buildings of the Army and Navy Departments with the "Cocon" Gallery (containing an exhibit of spun-silk articles), a field tent had been erected. Nearby was a trapdoor, beneath which electric wires ran. In some inexplicable manner two of these wires came into contact, and produced sparks which ignited the woodwork of the door. An attendant saw the smoke rising and lifted the door. A sheet of flame shot up which immediately set fire to the sun-dried wooden walls of the tent. In ten minutes the entire exposition was a furnace. The uncovered rotunda and the two large galleries offered no resistance to the flames; and the fire spread rapidly in all directions. Walls fell in with a thundering crash and buried glass cases containing many costly exhibits. Strange to relate, not a single human being lost his life, although the entire force of attendants was present and the booths were crowded. In a half hour after the flames were discovered, the exposition-buildings were mere shapeless heaps of iron, molten glass, broken machinery, bent plates of tin, and twisted iron wires. Of all the splendid fabrics, the embroideries, the velvet stuffs, not a vestige was to be found. Only the stone portions of the pavilion in which Volta mementoes were preserved and the walls of the boiler-house still remained standing. Only a few Volta reliques, such as the portrait of the great physicist, his sword, a few of his books, were saved from the flames. The first piles which he made, the first plan of an electric telegraph, the electric pistol, many documents and letters written by him and by other famous savants, in a word, many priceless treasures, were destroyed. The art works in the fine arts building were saved. All Como was naturally dismayed at the catastrophe; but the people soon plucked up courage and set about the restoration of the destroyed buildings.—Ueber Land und Meer.

[Continued from SUPPLEMENT, No. 1235, page 19794.]

THE RELATIONS OF PHYSICS AND ASTRONOMY TO THE DEVELOPMENT OF THE MECHANIC ARTS.*

By Prof. CLEVELAND ABBE,
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VI. SCIENCE STIMULATES THE MECHANICAL ARTS.

THE demand for measurements of the highest attainable accuracy is characteristic of the study of astronomy and physics, and always keeps in excess, or, more properly, in advance, of the current state of the art of construction. Consequently, the needs of science have made many demands upon the mechanical arts, and have steadily stimulated their progress. Science and art mutually stand to each other as cause and effect. The demand has always exceeded the supply. The supply has always, eventually, responded to the demand. The patrons of physics, and especially of astronomy, have always been willing to pay for the highest art, and no instrument-maker of genius has labored without abundant recognition.

Consider the manufacture of optical glass, which has reached its highest development in such works as those of Chance & Company, Feil & Company, and the School of Glass Technology establishment at Jena (under the control of Schott and Prof. Ernest Abbe). Here are manufactured great plates of optically perfect glass, having any required characteristic as to refractive and dispersive power, or even as to elastic and electric properties.

The construction of telescope lenses as perfected by Alvan Clark, and of microscope lenses by many artists too numerous to mention, all involve mechanical processes of the rarest delicacy, and illustrate how perfectly one class of men, the mechanicians, have been able to realize the ideals conceived by another class of men—the investigators.

The mounting of the great steel tube and all the accessories of the telescope, the construction of the revolving dome and the movable floor by such firms as Warner & Swazey, all demand the best engineering, while the delicate micrometer, with its perfect measuring screw, the spectroscope, the photometer, the camera, the chronograph and the clock, the transit instrument with its perfect pivots, the vertical circle with its delicate graduations, the altazimuth instrument and the spirit-level on which everything depends, each and all call for the most delicate manipulation, the most absolute homogeneity of material, freedom from internal strain, the finest work with the lathe, dividing and planing machines and numerous other characteristics of the highest type of the mechanical arts.

For two centuries past the stationary astronomical clocks and, especially of late years, the portable chronometers used by navigators at sea, by explorers on the land, by geodesists and astronomers everywhere, have been reckoned among the marvels of mechanism. Hundreds of men have directed their best thoughts to the perfecting of these time-pieces, so that they shall respond to the needs of the practical astronomer. From this work has resulted the possibility of the establishment of the manufactories of high class watches on an immense scale, so that now every one purchases, for a few dollars, that which a century ago it was entirely impossible to obtain. We wind our watches daily and boast of their accuracy to within a few seconds, quite forgetful of the fact that the astronomer and mechanician had to combine together to evolve this great system by which a million time-pieces of high character are annually manufactured for popular use. But, not satisfied with this, the scientist takes the most perfect specimen of all these and uses it in pushing his astronomical studies to a still higher perfection.

Astronomy is often called the parent of all the sciences, because it is said to have been the first in the order of development. But it has also been the foster parent, because astronomers found it necessary to develop, encourage, and protect every other branch of science in order that their own might prosper. Astronomy has demanded the most perfect apparatus. The command of large funds consecrated to this work by generous patrons has enabled astronomers to stimulate active minds and nimble fingers so as to secure those triumphs of accurate workmanship that are necessary to the advance of every branch of science. In this way the sextant and chronometer came to be devised for the navigator; the theodolite, the base apparatus, the pendulum apparatus, and the spirit level were devised for the use of the geodesist; the Gaussian apparatus for the study of terrestrial magnetism; the modern balance for the use of the chemist; the self-recorder for the use of the meteorologist.

When the investigator needs better apparatus, he usually invents or designs its necessary features and then calls in the mechanician to help construct it; the former discerns the sources of error and the latter devises methods to overcome them. Generally, the student leads the mechanician; science directs the art of the mechanic; the mind guides the hand.

The popular idea of science includes both the increase and the diffusion of knowledge; to the general English reader the scientist may be either a discoverer, an investigator, or a teacher. But the teacher cannot exist without the discoverer. Since the investigator must add to the sum total of human knowledge in order that the teacher may have something to teach, therefore, he must know both what has been done by others and, also, how to improve upon that. He, therefore, it is who is the true inventor, the one who finds out; and it is he who in his desire to study deeper stimulates the mechanic to produce better tools and apparatus. Thus it is that both the astronomer and the physicist and all the special students of nature take a prominent part in the development of more perfect apparatus.

They must have the means to make better measurements of length, area, and volume, of time, velocity, and angle, of weight, mass, attraction and repulsion, of electrical current and resistance, density, and potential, conductivity and capacity; of temperature and heat, expansion and radiation. They must have all the apparatus especially appropriate to the study of heat and light, elasticity, gravity and electricity. The best they have to-day will not be good enough for to-morrow.

VII. FUNDAMENTAL IMPROVEMENTS IN MACHINES FOLLOW THE DEVELOPMENT OF FUNDAMENTAL PRINCIPLES IN SCIENCE.

Every important advance in the mechanic arts has been preceded by special scientific investigation and the determination of data that were fundamentally necessary to the success of that particular advancement. This seems like a very strong and, perhaps, a rash statement. I may not have made an exhaustive examination of the subject; there may be an exception to the rule; but we shall find so many illustrations of its truth that we must accept its general application in modern times, whatever may have been true in the earliest stages of the arts. At the present time, those whose tastes incline them to research pave the road for those whose tastes incline them to invention and manufacture. The heroes of invention and manufacture would still be lost in the wilderness of ignorance had not the devotees of science prepared a highway and paved it with a solid Belgian pavement of blocks of knowledge on which all may march to success.

I will illustrate this by, first of all, considering the subject of the efficiency of a machine.

In the construction of a tool or machine every device has for its object to secure the attainment of some specific motion or result with the greatest possible economy of force, in the least possible time, with the least possible waste of material. The original source of our power may be falling water or tidal waves, the burning of coal or the consumption of some precious metal, it may be the wind or the direct energy of sunlight, or that indirect effect of gravitation represented by the electric currents that flow through the earth and atmosphere. In extreme cases, we may go back to the old-fashioned sources of power, the horse, the dog, or the man working in a treadmill, or traveling round and round in a circle. But in every case, we nowadays have to compute the ratio between the cost of the power and the value of the work that we finally get out of it. This involves essentially the question of the relation of the motor power itself to the amount of resulting work. This latter ratio we call the mechanical efficiency of the machine; the perfect machine of modern times is characterized by a large per cent. of efficiency. For instance, we use an ax to split logs of wood. A dull ax, or one whose blades are rough or wrongly inclined to each other, will waste a large percentage of our strength in friction and unnecessary resistances. After we have given it a sharp edge and a proper angle of cleavage, we still have to consider the ratio of its weight or mass to the power available in our muscles and the resisting power of the log that is to be split. With a small mass in the head of the ax, such as 3 to 5 pounds, we should in vain attempt to cut the tough wood that would yield to a heavier ax of from 5 to 7 pounds.

Among our natural sources of power we reckon the wind as one of the earliest to be used and still one of the most important. To increase and to measure the efficiency of a windmill is a problem that has taxed the genius of our best inventors and students. It is not measured by the quantity of work done per hour, but by the ratio of that to the work done by the wind in passing between the sails of the windmill. Having given up some of its momentum to the sails, the wind must still retain a large portion in order that it may move onward and make room for a fresh supply of air that is coming onward from behind. It would not be advisable to abstract from the wind more than one-half of its momentum, therefore, from this point of view, the efficiency of the windmill sail should not exceed 50 per cent.; this is the external efficiency of the mill. If now we compare the work done at one end of the machine with the energy of the revolving windmill sails at the other end, we obtain the internal efficiency of the mill, which in properly constructed apparatus may be as high as the factor for the best machinery of any other kind; but in fact, the windmill is not generally constructed with great care, and Prof. Franklin B. King, of Madison, Wis., finds but a small percentage for the best windmill investigated by himself.

The mechanical efficiency of a machine is now recognized as a matter of the very highest importance. Much of our manufacturing competition is based upon the relative merits and relative expenses of running our machines. The modern methods of measuring efficiency and of investigating the sources of waste emanate always from those who are fully alive to the laws of force involved in all mechanical operations. They are essentially due to the physical laboratory and the mechanical laboratory. They often involve mathematical considerations of a very abstract character. Many an engineer keeps the records of his indicator card and sums up the foot pounds per minute in a mechanical sort of way that shows that he can have no conception of the labor given to the study of thermodynamics before this simple device could be made equally useful to the manufacturer and to the inventor. The former sees in it a record of how much his engine is wasting, the latter sees in it suggestions as to how to improve the machine. The indicator card is an application of physical laws to practical machine work that has during the past fifty years been quietly revolutionizing the construction and use of the steam engine.

The injector first made by Giffard, a French engineer, which, by the way, has received numerous important modifications by William Sellers & Company, of Philadelphia, must be allowed to be not an efficient machine from a mechanical point of view; but from a thermal point of view, it is almost perfectly efficient, since all the heat of the steam and the feed water goes back into the boiler; it is this that enables it to add to the efficiency of the steam engine as a whole.

The Bessemer process for making steel is a good illustration of a method that is highly efficient mechanically, thermally, chemically, and I may also say chronometrically, since the time required is reduced to a minimum, consequently also financially, and it is no wonder that we have now suddenly arrived at the age of steel as distinguished from the age of iron.

The process of welding by means of the electric current is another illustration of an economy of time, fuel and power that is truly remarkable. You will perceive that all these improvements were preceded by a long series of laborious scientific determinations of the necessary fundamental data.

The pumping of water by means of reciprocating force pumps, as distinguished from the rotary pumps, is a very ancient process, the crudeness of which, from a mechanical point of view, might have been thought to have been overcome by the rotary and centrifugal pumps. The reciprocating pump is still indispensable when great heights or resistances are to be overcome; but it is precisely also in this case that the strains upon the machinery are most dangerous to its welfare. Here come in the improvements made by your fellow member, Mr. D'Auria, whose devices have overcome important difficulties experienced in other machines, while at the same time he attains a remarkably high percentage of mechanical efficiency. If his construction of tubes and his arrangement for the flow of water and diminution of shocks is properly analyzed, it will, I think, be seen to be the outcome of a long study into the flow of water in rivers and channels. His application of theoretical hydrodynamics to the construction of pumping machinery is a fine illustration of my general principle that all the higher improvements that our present types of machines have received or are still susceptible of, in order to become more perfectly efficient, can only come from that profound study of mathematical and physical principles that belongs to the scientific and technological courses of our universities.

If any further evidence were wanted, you have only to consider the other side of the case, viz., the fearful sacrifice of time and money, human thought and human life that is represented by the thousands of useless devices that are annually patented by over-sanguine inventors. These usually proceed from men of little education or experience, who have heard, perhaps, that John Smith made a fortune out of his little invention, and vainly imagine that whatever is new and patentable is naturally of some value.

It would be impossible to quote to-night all the important inventions, even by members of the Franklin Institute, that illustrate the importance of economy and efficiency as the prime characteristic of any great invention, but I will mention, still, the brilliant invention of the sand blast by Mr. B. F. Tilghman. This simple jet of air or steam with sand does in a few minutes the work of cutting that the finest engravers might spend years in doing. It substitutes machinery for the engraver's hand; but, of course, it cannot replace the artistic imagination of the famous cutters of gems. The mechanical principles involved in this process were explained by Prof. Osborne Reynolds in The Philosophical Magazine for November, 1873. The first and fundamental item is a law of impact, viz., that at the instant of first contact the pressure between two bodies is independent of their size, their mass or their velocity, but depends principally upon the density of the bodies and their hardness, so that a dense soft body may cause as much pressure as a less dense but hard body.

Singularly enough, very much the same principle applies to the soaring flight of a horizontal plane surface flying through the air. If the plane were to fall vertically from rest to the ground, it would quickly set all the air below it in motion outward in all directions, and would fall more rapidly because falling with the moving air; but when flying horizontally, it experiences at every moment the necessity of giving motion to a fresh mass of quiet air. It falls more slowly, as if experiencing a greater resistance. In this way, the air considered as a soft body causes an upward pressure sufficient to support a heavy body for a long time. So in the sand blast, the first effect of the impact of the grains of quartz is to impress on the molecules of the softer glass a slight motion, which is a certain percentage of the movement of the harder particles of sand, and just sufficient to tear them away, one at a time, from the rest of the glass.

You will perceive that Reynolds' law applies again to the polishing burr wheel, to the spinning of sheet iron and tin plates and to the cutting of stones, metals, and glass by the edge of the rapidly revolving wheel of soft lead or copper.

Prof. Reynolds shows that, in order to produce the same effect, a sand blast cutting into lead must have a velocity about eight times as great as when cutting into glass, the ratio depending upon the relative densities of the lead and glass.

* Address delivered at the inaugural meeting, May 19, 1899, of the Franklin Institute and published in the Journal of the Institute, to which we are indebted.

The geologist has occasion to apply these same principles, since the sand blast is always at work eroding the face of the earth with the help of wind and water.

I cannot refrain from quoting another modern invention that illustrates the recent application of simple physical principles to machines. I do not know the personal history of the inventor of that which we call the "Babcock Cream Separator," but he must have been a student of physics who first proposed to substitute centrifugal force for the force of gravity. As you all know, the particles of cream rise to the surface of quiet milk because of their buoyancy. Cream is specifically lighter, or has less density, than water. Gravity pulls down the water harder than it pulls the milk, and therefore the water pushes the cream up by a hydrostatic pressure that it owes to the attraction of gravitation. Mr. Babcock puts his milk into a rapidly revolving cylinder; the rotation gives rise to a centrifugal force, all particles have the same rotatory velocity, but each particle of water being denser than a particle of cream of the same size, is pressed outward by its centrifugal force more forcibly than the particle of cream. Thus, therefore, a great centrifugal force is used in place of gentle gravity to generate a great difference in centrifugal pressure, and thus quickly force the separation of the water from the cream.

In a very analogous way, the drier in a modern laundry, whirling rapidly around, separates the water from the wet cloth by centrifugal action.

So, also, the whirling atmosphere of the earth drives cold air from the north pole toward the equator, pushing aside the warm south winds.

Among the many branches of physics that are studied in the laboratory, none has more interest than the flow of metals, whether elastic or non-elastic. All that we have learned about this subject has found immediate application, first, in the improvement of the ancient process of wire drawing, second in the modern process of rolling rails; again, in the still more modern process of drawing the seamless tubes, and, finally, in the rolling of the immense plates for our ironclads.

The steam locomotive is often said to have begun with the work done by Oliver Evans, of Philadelphia, in 1772. The improvements made by George Stevenson, of England, for a while gave English engines a high position as models; but since those days Philadelphia has come to the front, and the Baldwin Locomotive Works are now sending their engines to England herself. You all know from personal experience that the modern locomotive embodies at every point the best thought of investigating physicists and illustrates again the absolute necessity of securing for our inventors, engineers and manufacturers the best graduates of our best technical schools.

You will not, therefore, be surprised if I emphatically urge upon your attention the general principle that the relation of astronomy and physics to the mechanic arts is not wholly an historical one, in that astronomy and physics preceded and fostered all important improvements, nor is it merely one of dependence, in that astronomy and physics look to the mechanician for the perfect apparatus. It is not merely a relation, but a relationship and a close one. It is a twinship, in fact, a Siamesian twinship where the blood of each flows through the other. If art is the right hand, science is the left. If one is the tool, the other is the worker. Neither advances without the other; if one steps forward to-day, the other steps forward to-morrow.

Among the most important features of the development of modern mechanics has been the introduction of a class of machinery sometimes designated as machine tools, by which we mean machinery that is more or less perfectly automatic and designed for the construction of many copies of some one part of another machine rather than for the direct manufacture of crude material as in textile work. These parts were formerly made entirely by hand; they were forged or filed, sawn and hammered, scraped and polished until they were of the proper size, shape and smoothness. A watch, for instance, is a machine intended to keep correct time; every portion of it, from the minutest screws and pivots to the chasing on the outside of the cover, was formerly done by skillful hands, and the expenditure of time and labor was enormous, while the resulting mechanisms always presented minute differences, such that no two similar parts of two watches could be interchanged. Now, however, tools are available by which every part of the watch is made by machinery. The human hand and eye scarcely ever intervene, the similar parts are always interchangeable, and the resulting watches are, to a very great extent, perfectly comparable with each other in their performances as timekeepers. Just as a file is a simple tool in the hands of the workman, so the Waltham lathes, planing machines, engraving machines, screw-cutting apparatus and drilling machines are complex tools, namely, machine tools, for manufacturing the parts of a watch.

The history of the modern development of the mechanic arts is the history of the application of the highest science to the perfection of the machine tool.

But a machine tool may be almost useless without the steady supply of power necessary to drive it. The foot lathe is a simple machine tool, but it cannot be applied to fine work on a very large scale, such as that now required, owing to the unreliability and irregularity of the power that is used as the prime motor. The development of the modern lathe and its application to innumerable problems was necessarily dependent upon the invention of the steam engine, the turbine wheel and the dynamo, all of which furnish an abundant and perfectly equable supply of power that can easily be transmitted to any desired spot.

Among the important machine tools we may quote the lathe as applied to the cutting of screws and the production of all manner of symmetrical surfaces; the planing machine, for flat and curved surfaces; the drilling machine, for cylindrical pits; the boring machine, for hollow tubes. Modifications of the lathe are seen in the vertical drilling machine and the slot-drilling machine. The machinery for making the blocks that are used in connection with tackle was one of the earliest machine tools. The trip hammer, as modified by Nasmyth into the steam hammer, works as if endowed with intelligence. The rivet machine replaces hundreds of laboring men, but makes it possible to set thousands at work on other lines.

A very important class of tools is that for testing and measuring the dimensions and the fitting of the various parts of a machine. When once a perfect machine or tool has been made, there immediately comes a demand for perfect copies of it, and these cannot be made without accurate measuring machines and machine tools that are correspondingly accurate. The great advantage to be derived from the system of manufacture in which each part of a machine is identical in size and shape with the similar parts of other machines was appreciated in England many years ago, and was especially insisted upon by Sir Joseph Whitworth. The perfect measuring machines that are necessary to carry out this idea have, however, been manufactured and used most freely in this country, William Sellers and Brown & Sharpe being well known in this work. The average errors of properly made interchangeable parts of a machine will not, in the present state of the art, exceed one thousandth part an inch, and even in the largest cylinders and pistons of a steam engine freshly turned out of a huge lathe, there ought not to be an error of one hundredth part of an inch or the ten thousandth part of their own diameter. Still greater accuracy can be attained whenever needed.

Some of the heaviest and, at the same time, most accurate machine tools are those built for the purpose of manufacturing heavy ordnance, armor plate and the machinery of the great naval vessels of the world. In the construction of these the best engineering talent and the soundest scientific knowledge are always utilized. They illustrate the best that can be done at the present time; but who can tell what another year may bring forth?

We have spoken of the mechanic arts as though we have to deal only with working tools and moving machinery; but, of course, all great stationary engineering structures, being themselves the products of the mechanic arts, illustrate, on the one hand, the perfection to which the arts have attained, and, on the other hand, the physical problems that must be solved in the course of this progressive development of the arts. Within our own lifetime we recall such monuments as the tubular bridges over the Menai Straits and over the St. Lawrence, the suspension bridges over the Niagara and the East Rivers, the London Crystal Palace of 1851, the Eiffel Tower at Paris, and the Ferris Wheel at Chicago. These were only possible after machinery had been devised for rolling the iron and steel, cutting and bending it, punching and twisting it in all directions, and, finally, testing every portion of the structure as to its strength and expansion with stress and temperature. Even in the fine arts, our pianos, organs, and brass instruments respond to the increasing knowledge of physics and the finer arts of the modern mechanic. Only the violin remains as yet unimproved by the progress of the mechanical arts.

Perhaps the modern bicycle illustrates, in a small way, that which the dynamo and electric motors do in a large way, the fact that at every turn our knowledge of physics is of vital importance to our future progress. It is about thirty years since the first French bicycles made their appearance. The idea, that is to say, the invention, was ingenious, but it was impossible to popularize this vehicle in its first crude stage. The wheels were simply those of a small ordinary wagon; the tire was iron for the sake of durability; both front and back wheels were too large, so that an unnecessary strain was brought upon the rider, which proved disastrous to many. Since those days successive changes have taken place; the iron tire is replaced by the India rubber pneumatic tube; the heavy wheel of the wheelwright gives place to the elegant steel wheel and frame; the chain and sprocket give place to perfectly beveled cog-wheels and rods. The fatiguing journey then indulged in as an athletic exercise now becomes the regular and easy work of an hour in discharge of one's daily duties, to say nothing of touring for pleasure, day after day, all summer long. Every step in this progress has been, and every step in future development will be, but an application of principles discovered and taught in the physical laboratories of our universities.

(To be continued.)

LIGHTHOUSE ILLUMINANTS.

By LAWRENCE IRWELL.

IN the reign of the English king Henry VII. (1485–1509), there existed a company of mariners who had authority by charter to prosecute persons who destroyed sea marks, etc. In May, 1514, Henry VIII. formed this company into a perpetual corporation by the style of the "Master Wardens and Assistants of the Guild of the Undivided Trinity, in the Parish of Deptford Strond in the County of Kent." Although the functions of this society have been very much curtailed, the shipping world owes to it a debt of gratitude, since it was the originator of the first attempt at the scientific illumination of dangerous spots on the coast.

The methods employed to utilize the light given out by the burning of oil are two—the catoptric (*a*) and the dioptric (*b*) systems. The first named of these necessitates the use of a number of small lamps, each with a polished reflector behind it, while the latter employs one central lamp and an adaptation of lenses.

Where gas is used in a lighthouse it has, of course, to be manufactured with the utmost care, and the use of this illuminant necessitates a very material increase in the lighthouse staff. The Wigham patent gas burner was introduced in 1865. This burner consists of five concentric rings of gas jets, the innermost ring having twenty-eight, the next forty-eight, then sixty-eight, and the outermost 108 burners. The diameter of each ring is 4, 6¼, 8½, 9½ and 11 inches. It is said that the light from twenty-eight gas jets is equal to four wicks where oil is consumed. By bringing more gas burners into use the light can be adjusted to suit the condition of the atmosphere. Fog, the most potent of atmospheric light-quenchers, is less able to extinguish the rays of gas light than those emanating from any other source. It is sometimes urged in objection to gas as a lighthouse illuminant that it is impossible to direct all the light—that the well-known gas glare cannot be obviated, even with the most perfect apparatus and appurtenances—but this is not an important objection. The zone of vague illumination serves to reveal in dense weather the whereabouts of the lighthouse, although the optical opacity of the atmosphere may be such as to quench all the directed rays. The cost of lighthouse gas never exceeds $3 per thousand feet. This is, of course, far above the cost of a similar quantity of coal gas manufactured for domestic purposes. The discrepancy in price is accounted for by the small quantity usually made at each station, and also by the best possible coal being employed in the process. The relative intensity of this special coal gas compared with the gas manufactured for domestic consumption is as thirty-five to sixteen. The late Prof. Tyndall thus pronounced upon the merits of gas as a lighthouse illuminant: "It may be beaten in point of cheapness by mineral oil, but in point of handiness, distinctiveness and power of variability to meet the changes of the weather, it will maintain its superiority over all oils."

Much was expected from the electric light. Its intensity is such that many persons believed it would shine steadily and distinctly through all conditions of atmosphere. But these expectations have not been fulfilled. Vivid it is, and searching it may be, but its utter inability to penetrate through a fog of any density has been conclusively proved. The British Shipmasters' Society reported in 1891 that "many members of this society on active service frequently passing from the Thames to the sea, and vice versa, have often represented the poorness, sometimes invisibility, of the electric lights during certain conditions of hazy atmosphere, at times when the oil lights of lightships, etc., and the gas lights of seaside towns have been comparatively bright and distinct. Again, complaints have been made of the intense and blinding effects produced on navigators by electric lights, such as the South Foreland, on vessels in its immediate vicinity." This is the opinion of those mainly concerned in the efficacy of warning lights, whose very lives depend upon the vividness of the friendly rays emerging from the lantern towers. This verdict is indorsed by nautical opinion in this country, and those interested in good lighting as long ago as 1890 requested that the electric light be withdrawn. As far as the writer has been able to ascertain, oil is almost universally used in American lighthouses. The beacon at Sandy Hook is still lighted by electricity, as are some of the buoys at the entrance to New York Harbor. The electric light at Hell Gate was discontinued in 1886 because its brilliancy dazzled the eyes of pilots and prevented them from seeing objects beyond the illuminated circle. The French lighthouse authorities have given the electric light a prolonged trial, but it caused so much dissatisfaction and so many complaints that it has been gradually abandoned.

There is, however, one service which the electric mode of illumination performs in a thoroughly satisfactory manner. Sky-flash signals are, of course, referred to. A beam of light thrown into the upper sky is extremely useful to navigators in determining a ship's position before the true light itself is visible over the convexity of the earth. Supposing a ship making for shore sights an overhead light, she is enabled to locate her position thereby. If bad weather were now to come on, she would be able to steer in confidence in the direction of the true light and would come within its range, although had she not been guided by seeing the overhead light before the bad weather came on she would have had to grope her way until well within the zone of the true light. In many conditions of weather, as may readily be imagined, the vertical beam would not be of the slightest use. How far off the sky-flash light can be seen is difficult to determine. The Hollman light on the coast of Denmark has been discerned at a distance of fifty-one miles; the Calais light (France) at a distance of thirty-six miles, and several English lights at distances varying between forty-one and forty-nine miles.

Light is not, however, only thrown from some lighthouses upon the sky, but at many towers there are subsidiary beams which are used to throw light upon some danger spot in the immediate vicinity of the lighthouse. For this purpose colored lights are usually employed. But their use is attended with so much loss of power that it is but rarely that they are employed as first-class principal lights. Red is more often used than green, and the latter color is not employed as a main feature in any lighthouse. If a red beam of light is to produce the same effect at the same distance as a beam of white light, then the quantitative ratio of the lights that produce the beams must be as twenty-one is to nine or ten, the extra amount of light being required for the red beam to compensate for the light absorbed in passing through the red glass. The importance of the work achieved by these subsidiary lights is best exemplified in the following manner: The sea surrounding the lighthouse is divided into eight irregular areas, each area being marked in a distinct manner. The main or seaward portion is the largest, having an illuminated arc of about 180 degrees. The other areas are, of course, much smaller in extent. Vertical strips of variously colored glass, through which the light is made to pass, illuminate the different areas in a most marked manner, the diversity of characteristics being aided by a tower light in the same tower 20 or 30 feet below the main light.

About six years ago the Wigham "Giant" lighthouse lens was introduced to the world. In the year 1885 a step in the direction of large lenses was taken by the commissioners of Irish lights when they established at the lighthouse on Belfast Lough lenses 4 feet high by 3 feet 7 inches in width, but still with the 920 millimeter focal distance. Later on experiments were made with a lens having the focal distance of 1,330 millimeters. This was known as a hyper-radiant lens, and it was found, when used in conjunction with large burners, to have practically double the illuminating power of any lens previously made. The "Giant" lens, however, has the axial (rotating) intensity of 800,000 candles, and when it is set up on the quadrilateral system, each of the four faces of the apparatus measures 10 feet wide by 22½ feet in height, and when fully equipped the emergent beam of light from the quadrilateral arrangement is calculated at 5,000,000 candles. In making this computation allowance has not been made for the fact that the peculiar spherical form of the lens will return to the flame the whole of the light reflected at the first

a—Catoptric—produced by reflection from mirrors.
b—Dioptric—produced by a central lamp through a combination of lenses surrounding it.

refracting surface, so as to increase the amount of light emitted directly from the flame toward an opposite panel, which light in the case of an ordinary plain lens is wholly lost. This apparatus seems to be about as perfect as human ingenuity can devise. Although no lighthouse illuminant has yet been produced that can satisfactorily penetrate fog, yet this light may be relied upon to illuminate the densest fog to some extent, and so show the approximate position of the lighthouse.

Concerning the electric light, it has been a subject of much controversy as to which nation first employed it as a lighthouse illuminant. In December, 1863, it was used by France. But as far back as 1857 experimental trials were made in England. In 1858 and 1859 that country made use of it at South Foreland. After February, 1862, the electric light shone from another tower—Dungeness. Since that date electricity has had a fair trial, and under certain atmospheric conditions—not very prevalent upon this side of the Atlantic—its powerful rays are found to be completely quenched. Now that all authorities are agreed that the electric light is not a complete success under all conditions, it remains to be seen to what extent coal gas will supersede oil.—Marine Review.

VAULTS WITHOUT CENTERINGS.

A REVOLUTION is taking place at the present time in the art of building, and certain processes, new as to their application, are daily tending to render the method of constructing edifices quicker, cheaper, and easier. Apropos of this, we have thought it would be of interest to say a few words concerning the modern method employed for the construction of vaults without the use of wooden centerings, which are very expensive and the establishment of which always occupies considerable time.

The great difficulty in the construction of a vault or of a cupola is to find a means of diminishing the weight of it. The pressures produced by the roofing of a large domed building always have results that necessitate the subordination of the entire structure to the exigencies of the domes and vaults. The lateral walls must be thick enough to resist the horizontal thrusts communicated by the vault, of which the tendency is to open and thus produce a spreading at the springings. This is so true that when Saint Augustin Church was built it was seen that it was impossible to make the dome rest upon the courses of stone, which even began to yield under the weight. It was then that the idea occurred to use cast iron columns, which, starting from the ground, are designed exclusively for supporting the entire roof. The dome of the church of the Sacré Cœur, at Montmartre, is of stone and its weight is formidable. Here, however, peculiar conditions were met with. No means were spared to establish a strong masonry, since, owing to the abundance of funds offered by public charity, no anxiety had to be felt as to the question of expense. In the middle ages, the epoch at which was begun the construction of the great naves of our Gothic churches, which will always be models of the most beautiful architecture that ever existed, the difficulty that walls had to encounter in order to overcome the horizontal thrusts of the roof was clearly perceived; and this is why external arch buttresses for consolidating the structure were established. Since, at this time, architects were artists before all else, they knew how to put such necessity to profit by transforming it into one of the happiest elements of decoration.

Now that we are in another era—an epoch of production, and especially of reproduction—we no longer have the leisure of our ancestors, who did not hesitate to devote an entire life to the sculpture of one window. Will our structures have the same longevity as those left to us by the fourteenth and fifteenth centuries and the Renaissance? It is not very probable.

The new results that we are going to describe have all the qualities required by the necessities of the age in which we live. They are very quickly constructed, are economical, and have certainly sufficient solidity to permit them to survive the buildings of soft and short-lived stone now in use. The principle of these vaults rests upon no precise rule, and the application of the system remains the property of specialists who are skillful men and almost all of them artists.

In order to construct a cupola according to the new processes, we begin by erecting in the interior of the work a movable scaffold to be used by the workmen, and that will be raised in measure as the operation of building proceeds. Light wooden guides are provided for directing the masons in the laying of the different courses of bricks, although such guides constitute merely a template, the only role of which is to control the work, and in no wise to sustain the masonry. The workmen establish crowns of 1¼-inch hollow bricks placed upon edge and made to adhere to one another by means of a plaster tempered in a special manner. This plaster, mixed in such a way as to form a paste, sets so readily that the bricks adhere to each other in less than ten seconds, even when they are situated at the summit of the cupola.

The courses are laid in succession, and the masons have a sufficient idea of sphericity to allow them to dispense with any other guide than the wooden template. If it is required of them, they may even form openings in the vault for windows or lunettes, as was done in the case of the cupolas of the Petit Palais of the Champs-Elysees, in which all the vaults were constructed according to this process.

As a general thing, a cupola constructed in the manner that we have just described has sufficient strength to sustain itself without any other aid, its resistance being explainable by its relatively feeble weight and its ovoid form. When the vault or cupola does not have to support a roof, courses of brick of 1½-inch thickness are employed, as in the case of the chapel of Rue Jean Goujon, in which three cupolas, one within the other, were constructed. Such is not always the case, however. The cupolas of the Petit Palais, for example, will be covered with decorative motives of zinc and a slate roof. As such an assemblage is very heavy, and as it would be asking too much to require a vault 1½ inch in thickness to support such a mass, the exterior in this case receives a layer of Vaugirard bricks. The vault then assumes a solidity proof against everything, since its thickness is 5 or 6 inches. A final facing of Portland cement renders the work secure against the effects of rain and humidity.

If, instead of having to construct a cupola, we had to construct a vault for the nave of a church or for a gallery, the same process would be followed. We should begin by establishing a binding arch of brick by means of a wooden template giving the exact form of the vault and then moving this pattern further along. The first arch constructed then becomes itself a sort of working template. The workmen stretch cords between the binding arch and the wooden template and set their bricks on edge, in courses, one alongside of another, and cement them together with the same kind of plaster that we have mentioned in connection with cupolas. After one row is finished, a second is begun, and then a third and fourth, and so on until the summit of the vault is reached. In such constructions open vaults may be formed to take the place of windows in a nave built according to this system.

To this effect, we endeavor by tentatives to find in space a point that shall be the center of the dirigent circumference of the cylinder of the penetrating vault, and, at such place, we establish a system composed of two pieces of assembled wood, the first vertical and the other having the direction of the open vault. In causing this system to turn around the base as a bearing point, the upper piece of wood will trace the form of the vault to be constructed and will thus serve as a guide for laying the bricks.

In churches of the Gothic style, it sometimes happens that facework with very complicated surfaces has to be executed. In such a case, we begin by construct-

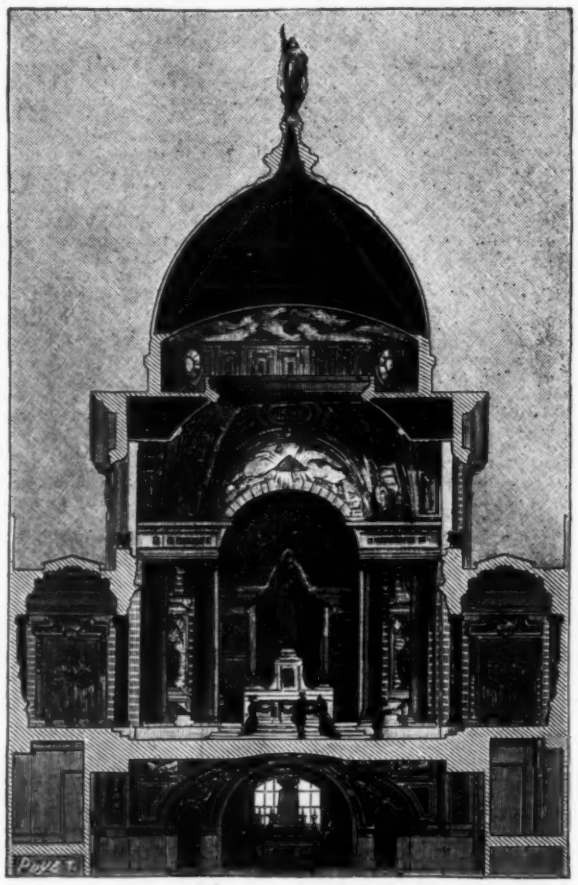


FIG. 1.—THE CHAPEL OF RUE JEAN GOUJON—THE THREE CUPOLAS OF THE DOME.

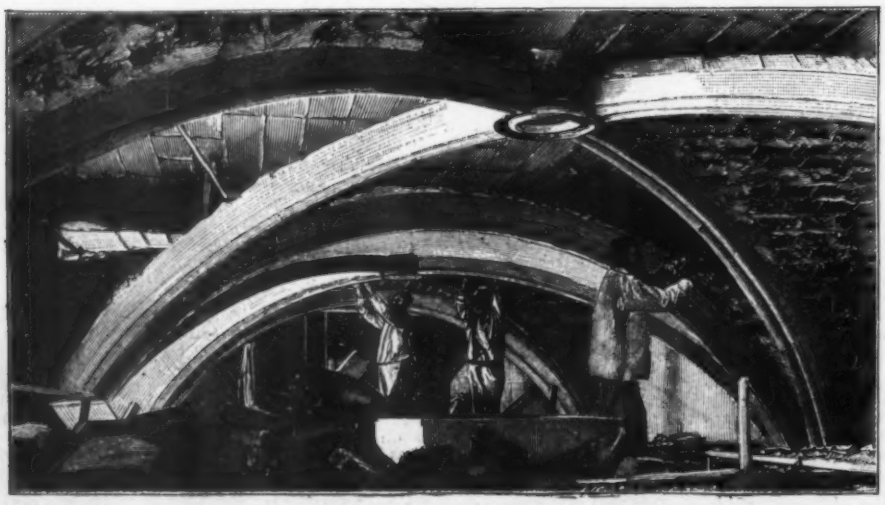


FIG. 2.—CONSTRUCTION OF A VAULT.

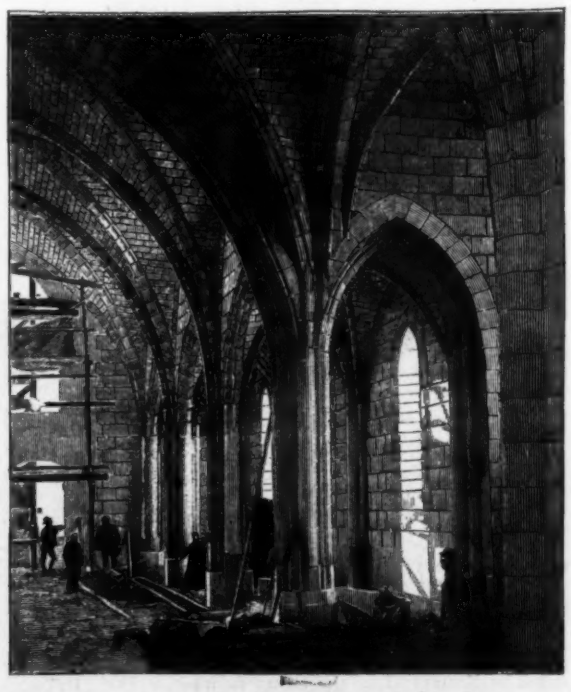


FIG. 3.—INTERIOR OF A CHURCH CONSTRUCTED BY THE PROCESS OF VAULTS WITHOUT CENTERINGS.

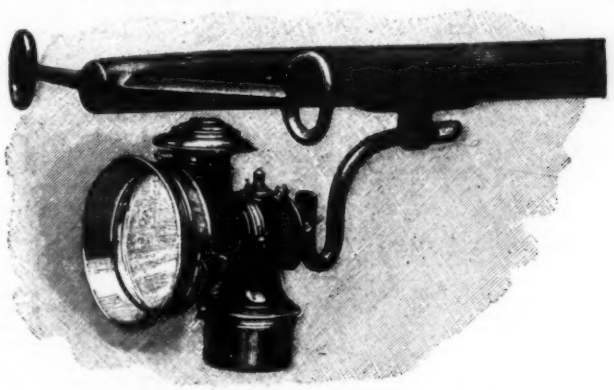
ing the binding arches, wall arches and groins through the aid of wooden guides. To this effect, special brick are used that present externally the form and moulding of the arch to be constructed. After this system has once been established, the masons lay their brick without being directed by anything but the general aspect of the curvature. After the bricks have been cemented together they are left to themselves, when they will quickly adhere to each other very strongly.

M. Favre, who is the specialist in this kind of work, has already constructed several churches according to this process, and has the contract for constructing the cupolas of the palaces of the Exposition of 1900.

For the above particulars and the illustrations we are indebted to La Nature.

AN ACETYLENE LAMP FOR WAGON-POLES.

AT the horse and carriage show held in Dresden last year, few devices attracted more attention than the lamp which is illustrated in the engraving annexed.



AN ACETYLENE WAGON-POLE LAMP.

The lamp in question burns acetylene gas, and is secured to the outer end of the carriage or wagon-pole by means of a bracket. Our German contemporary, Illustrirte Zeitung, states that the white light of the lamp is so intense that the road is illuminated for a distance of 50 meters (164 feet) in front of the carriage. The gas, even during high winds, burns without a flicker. The lamp carries enough carbide to burn uninterruptedly for five hours, and is so constructed that all danger of gas-explosion is averted.

ROSSELL'S SMOKE PREVENTER.

THE stringent action which is now being taken by many local authorities to minimize the smoke nuisance, as far as factory chimneys are concerned, has led to the introduction of various appliances for smoke abatement. An apparatus which has, we are told, achieved considerable success in Sheffield, where the smoke abatement question is one of moment, is being introduced by Messrs. Rossell & Company, of that town. The apparatus illustrated is designed to admit a supply of air above the fires immediately after the application of the green coal, when the smoke-producing elements of the fuel are distilled. The oxygen passing under the bars, and thence through the fires of an ordinary boiler-grate, should, if the latter is properly designed, be almost entirely converted into CO_2, as it emerges from the surface of the fires. Thus, when the air supply through the bars is arranged for economic combustion by diminishing the excess as far as practicable, then the extra supply of air needed to consume the volatile and smoky constituents is not forthcoming. By means of the apparatus illustrated the additional supply of air referred to as necessary is passed, for a period of two or three minutes, through specially made automatic shutters fitted to the fire-door. In this way the minimum and most efficient air supply through the grate-bars is secured, and at the same time supplemented only when required by the air passed through the shutters.

Referring to the illustrations, Fig. 2 represents the front of a Cornish boiler fitted with the appliance, and Fig. 1 is a section through the fire-door and automatic regulator. The door is mounted upon hinges in the ordinary way; it is fully opened while firing, and afterward closed by the fireman. These two operations set the automatic gear in motion, so that the auxiliary supply of air, when once regulated, needs no further attention.

The shutters, *I*, are pivoted to the door, so that they fit closely together when the finger, *F*, is in its lowest position. The finger, *F*, presses upon a swell or bulb existing only at the center of each shutter. The upward movement of the finger, *F*, caused by opening the door, simultaneously raises the bulbs, each being in contact with the next, and thus permits the passage of air between the flat sections of the shutters. The pivoting of the shutters is arranged very simply, and as the bulbs on the shutters merely rest one upon the other, to replace a damaged shutter requires no fitting, and may be done in a few moments. The accessibility of the shutters is also of great importance in enabling them to be kept free from dirt. The finger, *F*, is carried upon a vertical rod, *H*, turned to slide in a guide, *M*, and fitted at its lower end with a piston working in a cataract cylinder filled with oil, the cylinder being carried on the swinging door. The upper end of the rod, *H*, carries a spherical weight, *N*. The lever, *L*, is pivoted to a bracket upon the cylinder cover, and has a forked end embracing a projecting stud, *S*, on the rod, *H*. The other extremity of this lever is bent downward, so that, as the fire-door is opened, the inclined end of the lever dips under the fixed bracket, *K*, the latter depressing the inclined end, and thus lifting the forked end of *L*, so raising the finger, *F*, carried on the rod, *H*, and fully opening the shutters in the door. During the ascent of the rod, *H*, the piston attached to its lower ends lifts, and the oil confined in the upper part of the cylinder is displaced to the lower cavity, flowing easily through non-return valves in the piston, and to a small extent through the communicating pipe, *D*, the available area of which is controlled by the plug cock, *C*. The fireman having opened the door, and so caused the shutters to automatically open, as described, now proceeds to fire, and while this is being done the weighted rod, *H*, is maintained in its highest position by the pressure of the lever, *L*, against the stop or projecting bracket, *K*. When the firing is completed the door is swung to, thus releasing the lever, which no longer restrains the downward motion of the weighted rod, *H*. As the weight descends, lowering the finger, *F*, and consequently gradually closing the air spaces between the shutters, the oil is again displaced from the lower to the upper side of the piston. Owing to the action of the non-return valves in the piston, the whole volume of confined oil must now escape from one side of the piston to the other through the pipe, *D*, and as the effective area of this pipe is under control by the cock, *C*, the time of displacement can be governed. It will now be understood that the shutters in the door are automatically opened to the fullest extent immediately after firing, and that the mechanism enables the duration of the auxiliary air supply to be regulated to a nicety by means of the cock, *C*. It should further be noted that the auxiliary supply is a maximum just after firing, and that it is gradually diminished as the volatile constituents are consumed. When the cock, *C*, is once regulated to suit the fuel used, it may be clamped in position, and will then need no further attention. The ordinary time for the closing of the shutters is from two to three minutes.—The Engineer.

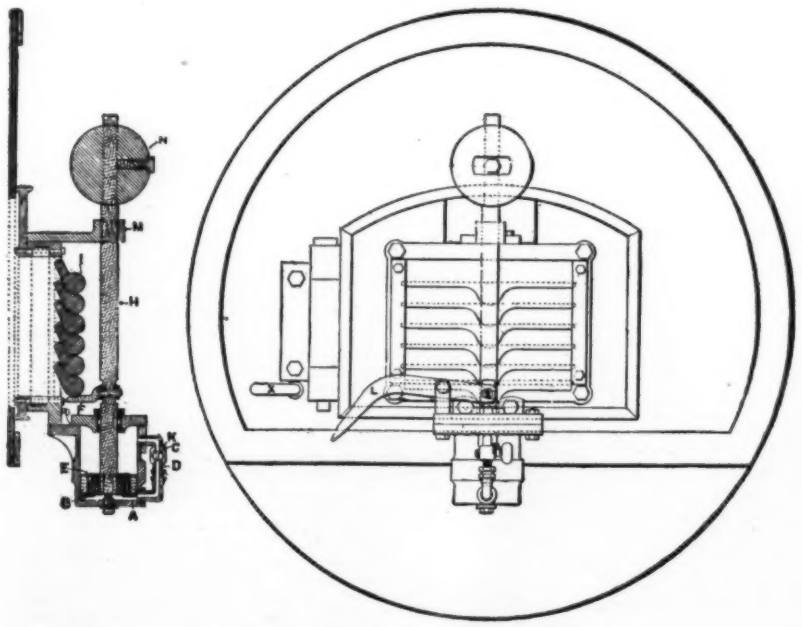


FIG. 1. FIG. 2.

ROSSELL'S AUTOMATIC FURNACE DOOR.

THE THEORY OF THE WEHNELT INTERRUPTER.

DR. B. WALTER, of Hamburg, who is well known in connection with investigations into the theory of the induction coil, contributes to the Fortschritte auf dem Gebiete der Röntgenstrahlen, vol. ii., an interesting article which throws new light upon the action of the Wehnelt interrupter.

It is a favorite theory among scientific men that the peculiar action of this interrupter depends on resonance. It has been supposed that the gaseous layer developed on the anode acted as a condenser of considerable capacity; and this, combined with the self-induction of the primary coil, supplied the conditions necessary to generate electric oscillations in the circuit. This view is proved to be erroneous, in Walter's opinion, by the fact that hydrogen only is set free on the cathode. If oscillating currents really existed in the circuit, we would expect to find a mixture of oxygen and hydrogen on the cathode.

On the other hand, Walter found by means of the spectroscope that both oxygen and hydrogen were developed on the anode. This led him to formulate the following theory. When the current first begins to flow, bubbles of oxygen are formed on the anode. Then the temperature rapidly rises till a layer of steam is formed round the anode. This is sufficiently non-conducting to cause a considerable reduction of current. The self-induction in the primary coil thereupon produces a considerable increase in E. M. F.; the layer of steam is electrolyzed into a mixture of explosive gases and finally exploded by a spark. The explosion drives the liquid completely away from the anode, and produces thereby a complete momentary cessation of the current. The current is, however, always unidirectional, never alternating. The presence of self-induction in the circuit is necessary to obtain sufficient E.M.F. to electrolyze the steam and explode the mixture of oxygen and hydrogen.

Walter considers that the construction of the present induction coils will have to be considerably modified to get the best results with the Wehnelt break. The thickness of the wire in the primary and secondary coils will require to be increased to prevent overheating; and better insulation will be necessary, since the extremely rapid breaks produce a tension in the coils which is almost electrostatic. Another important point is that the primary coils should be tuned to the break, i. e., for each break there is a definite self-induction in the primary which gives the best results.

The Wehnelt break should be made so that the length of the platinum anode, which projects into the electrolyte, can be readily adjusted. The platinum wire is, for this reason, made to slide in a glass or porcelain tube. The length of wire which projects from the end of the tube can be regulated by a screw or other suitable adjustment. For every tube and induction coil there is a certain length which gives the best result. As a general rule, for soft tubes, the length should be shorter, and for hard tubes longer. In practice, however, it is best to commence with a short length, say 1 mm., and gradually increase this till the best result is obtained. The magnitude of the current which produces the explosive break increases as the length of the platinum increases; and the theory of the induction coil shows that the tension in the secondary is proportional to this breaking current and the suddenness of the break. The frequency of the breaks is reduced by increasing the surface of the anode, but not to such an extent as to neutralize the effect of the increase of the breaking current.

As already mentioned, one of the most important conditions for the successful application of the Wehnelt break is the use of a primary coil with a definite self-induction. The primary coil which is best suited for the ordinary break does not, as a rule, give the best results with the Wehnelt. For instance, Walter found that the Wehnelt break on his 50-cm. induction coil gave a spark of only 10 to 12 cm.; but when the ordinary primary was replaced by the primary of a 30-cm. coil, the effect was tripled. Walter recommends that every induction coil should be supplied with an extra primary coil specially designed for use with the Wehnelt break.

The breaking current in the primary to produce a given length of secondary spark is much greater than with the ordinary break. From this it may be inferred that the output of a coil per unit of energy supplied is not so great with the Wehnelt as with the ordinary break. The output per unit of time, or what may be called the horse power of a coil, is, however, immensely greater with the Wehnelt.

These investigations of Walter's may be of considerable value in increasing the efficiency of Röntgen ray apparatus in which the Wehnelt is used. Walter has obtained a Röntgen photograph of the pelvis in ten seconds, and he thinks that this time may yet be considerably reduced.—The Electrical Review.

New Plastic Mass.—A process for producing plastic masses has lately been patented in Germany. Gelatin, glue or similar substances in an anhydrous state are intimately mixed with chromates in the finest subdivision with entire exclusion of moisture, anhydrous glycerin being simultaneously added. Thereby the action of the chrome combination is retarded to such an extent that the mass may be placed in molds, without subsequent change of volume, in which it is subjected to pressure with heat.—Gold und Silberwaren Industrie.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Trade Openings in Russia.—The last pamphlet (June, 1899) published by the Chamber of Commerce at Frankfort contains the following:

"NEW RUSSIAN MONTHLY MAGAZINE FOR TRADE AND INDUSTRY.

"For the purpose of fostering German trade relations with Russia, an illustrated monthly publication has just been founded in St. Petersburg, to bring to the attention of Russian merchants and consumers the names of German sources of supply and manufacturing firms. This enterprise promises to be advantageous to the German export trade, and is especially opportune, because a monthly magazine—the Russian-English Messenger—has been published in Moscow in the interest of English trade since November, 1898."

For the last five years, our National Association of Manufacturers in the United States and other trade associations, steamship and transportation lines have directed their efforts toward increasing our trade with Latin America. While I indorse all attempts to increase our exports, says Simon W. Hanauer, Vice Consul-General, of Frankfort, I believe that an equal amount of money, time, and energy expended upon furthering our trade relations with the great Russian empire would prove more profitable.

Russia has not only an immensely larger population than Latin America, thus affording us a wider market, but the vast empire offers the best and most profitable field for our promoters of railway, electric, and other enterprises, for the construction of waterworks and drainage systems, building streets and canals, works in iron, making dry docks and harbors, and opening mines. Americans have the most favorable chances to employ their capital and skill in Russia, as the people of that country are rather jealous of Europeans who figure in the role of pioneers, whereas they have no fear of American assistance in developing the resources of their country.

I would recommend my countrymen to "go east" and employ their talent, time, money, and energy in Russia, which will return them ample compensation.

Importation of Meat Into France.—Refrigerated beef coming from America is admitted into France in accordance with the official decree of May 26, 1888, concerning fresh meats imported from abroad, says U. S. Consul John K. Gowdy, of Paris. Such meat must be imported through the customs office specially designated for that purpose, and must undergo a sanitary inspection at the port of entry. The tariff for this inspection is one franc (19·3 cents) per 100 kilogrammes (220·46 pounds), and for no fraction of that weight.

In accordance with this decree the meat should be presented as complete animals, either entire or cut in halves or quarters, according to the usual custom of the butchers. The different pieces must correspond exactly, with the lungs naturally attached, and the adhering intestines of the chest and stomach should bear no trace of "scraping or scratchings."

Fresh pork is not allowed to enter France. In accordance with a decree of December 4, 1891, salted pork alone can be imported under certain conditions, the most important being that the pork must be thoroughly salted.

The decree in full, which appeared in the Journal Officiel of December 5, 1891, is as follows:

"The President of the French Republic, upon the report of the Minister of Agriculture,

"Considering the decrees of the 18th of February, 1881, and of December 28, 1883, in virtue whereby the importation into France of salt pork originating from the United States of America was forbidden;

"Considering the measures taken by the government of the United States to insure within its territory the sanitary inspection of meats intended for exportation;

"Considering the advice of the Ministers of Foreign Affairs, Treasury, of the Interior, of Commerce and Industry,

"Decrees:

"Article 1. Salted pork coming from the United States of America can be imported into France at the points on the frontier which will be determined by decree.

"Art. 2. Before the unloading of the goods the importers must produce for each consignment a certificate delivered by the inspector of the Department of Agriculture appointed by the government of the United States to watch the establishments in which the animals have been slaughtered and the meat has been dressed, stating that the said meat is of animals in a perfect state of health and is fit for consumption.

"The cases containing this meat must bear the stamp of the official inspector who has undertaken the sanitary examination of the meat.

"The entry upon the territory of the republic will be refused to all consignments which have not complied with the conditions indicated above.

"Art. 3. After unloading, the meat is submitted to the sanitary inspectors designated by the Minister of Agriculture, charged to assure themselves of its wholesomeness and that it is thoroughly salted.

"All meat recognized as unfit for consumption will be destroyed in the presence of these sanitary inspectors.

"Art. 4. The custom house officials will grant free entry into the territory of the republic only to the meats mentioned in article 1, on the presentation of the inspector's certificate provided for in article 3, stating that the meats have been recognized to be healthy and fit for public consumption.

"Art. 5. The expense of the service of inspection prescribed by article 3 will be paid by the importers, according to a tax fixed by decree rendered on the proposition of the Minister of Agriculture according to the advice of the Consulting Committee on Epizooty. This tax will be paid at the office of the collector of customs.

"Art. 6. Are and will remain canceled the decrees of February 18, 1881, and of December 28, 1883, as well as all dispositions which are contrary to the present decree.

"Art. 7. The Minister of Agriculture, the Minister of the Interior, the Minister of Commerce, of Industries and the Colonies, and the Minister of the Treasury, are charged, each, as to that which concerns him, with the execution of the present decree, which will come into effect on the 1st of January, 1892.

"Done at Paris the 4th of December, 1891."

As to preserved meat (so called), up to the present time its importation has not been subjected to any sanitary regulations on the part of the French authorities. Its introduction is subject to the payment of the duties provided for in article 19 of the customs tariff, as follows:

Preserved meat in cans, 20 francs ($3.86) per 100 kilogrammes (220·46 pounds), if direct to France from the United States, or 23·60 francs ($4.54) if through another European port or depot. This includes the weight of the tins or pots and the exterior packing.

Plans for Montevideo Port Works.—Minister Finch sends from Montevideo, May 26, 1899, copies of the plans and specifications for the proposed harbor works at that place. The plans, he says, call for a depth of 26 feet; but he is informed that the contract will call for 30 feet. Notice of the change will be given in the published proposals. The minister urges that American representatives, properly introduced, be sent to Uruguay to do the preliminary work. The money is to be paid in installments, as the work is completed. The plans have been filed in the Bureau of Foreign Commerce, where they can be examined by interested parties.

Japanese Tea Exports, 1898-99.—Consul-General Gowey sends from Yokohama, under date of May 16, 1899, statistics of the export of tea from Japan to the United States and Canada during the season 1898-99, as follows:

EXPORT.

	Pounds.
From Yokohama	25,946,020
From Kobé	13,985,219
Total	39,931,239

DESTINATION.

	Pounds.
New York and East	9,963,328
Chicago and West	13,340,815
San Francisco and Pacific Coast	4,362,089
Canada	12,265,007
Total	39,931,239

History of the Naphtha Industry in Russia.—Two very serious crises in this branch of the mining industry were averted by the influx of foreign capital, says United States Consul Thomas Smith, of Moscow, June 13, 1899. In 1873 and 1874, the existing system of monopolies was altered by leasing the naphtha lands. Russian promoters spent considerable amounts for the leases, but in the long run there was such a deficiency of working capital that even the largest undertakings were in danger of liquidation.

The Swedish capitalist Mr. Robert Nobel, who arrived in Russia about that time, recognized the large profits to be obtained from the naphtha business and started an immense undertaking. The crisis in 1877 did not have any serious results, thanks to the capital of Nobel, who, by loans, saved the naphtha industry promoters connected with him in business from bankruptcy.

In 1883 a large naphtha undertaking, "Bnito," was organized, excellently managed both technically and commercially; but this also experienced a deficiency of capital. The principal founders of the concern became bankrupt. The Paris firm of Messrs. Rothschild went into the matter, bought up a considerable part of the shares, and opened a credit to the Baku manufacturers of 2,000,000 rubles ($1,000,000) at 6 per cent. annually, on condition that all the material intended for export should be made over to them for sale in the foreign markets. In this way the expected crisis was averted.

The foreign promoters further co-operated in the progress of the naphtha industry by the construction of a pipe line, the adoption of cistern wagons, distillery boilers, and other technical improvements. Good results are expected from the influx of English capital at the present time. In 1896 and 1898, about 18,000,000 rubles ($9,000,000) were invested, and thus 4·6 per cent. of the naphtha-producing area of Baku belongs to the English. Their profits amount to 17 per cent. of the whole proceeds. Of the 6,000 dessiatines (14,200 acres) of naphtha-producing ground, only 500, or about 8 per cent., are actually worked.

Uses of Tobacco Juice in France.—In reply to a Kentucky correspondent, Consul Van Buren writes from Nice, July 13, 1899, as follows:

Information as to total exports, number of factories, output, etc., should be procured in Paris. The government has a monopoly of the manufacture and sale of tobacco and its extracts in this country. Detailed statements can be obtained only from the Direction Générale des Tabacs au Ministère des Finances in Paris.

There is a tobacco factory here, and its director has informed me that no extracts of tobacco are manufactured. All tobacco shops, however, which in France are specially licensed and privileged, are compelled to keep a stock of what is called "tobacco juice, rich in nicotine, and guaranteed." This is manufactured, as far as I am enabled to ascertain, by the tobacco monopoly in Paris. This article, it is claimed, possesses the following advantages:

1. It is free from all matter susceptible of fermentation and keeps for an indefinite period of time if in closed vessels.

2. It contains no resinous matter and is almost transparent; therefore, it does not injure or clog the spraying machines, and does not stain plants or flowers or the wool of sheep.

3. It has a government guarantee as to the proportion of nicotine it contains, which never varies.

This product, sold throughout this department, as well as in other parts of France, is packed in tins of 5 liters (1·3209 gallons), 1 liter (1·0567 quarts), and half a liter (0·5283 quart), at the following prices:

	Francs.	
5 liters	13·50	= $2·61
1 liter	3·00	= 0·58
Half a liter	1·75	= 0·34

It is claimed that this product contains from five to six times the quantity of nicotine that may be found in ordinary tobacco juice, and that, therefore, one-fifth to one-sixth of the quantity will accomplish the object to which it is applied.

For spraying purposes, the product is employed in the proportion of one part of juice to one hundred parts of water. It is stated that the spraying of plants should be done after sunset, and that they should be sprinkled with clear water on the following day. For fumigating hothouses, the proportion is one part of juice to five of water. The mixture is sprayed upon bricks or iron sheets heated to a temperature sufficiently high to produce rapid evaporation. It is claimed that insects and parasites are absolutely destroyed by this process. It is said, furthermore, that the preparation is most efficacious for the destruction of all insects in cattle, as well as being a preventive of all manner of parasitic attacks. For these purposes the juice is mixed in the proportion of one part to twenty of water. It is recommended that the lotion be not used as a general bath, but applied gradually on limited surfaces. It should not be brought in contact with sores or erosions of any kind. The benefits accruing from the use of these mixtures are said to be greatly enhanced by mixing 100 grammes (3·527 ounces) of soda crystals with each liter of diluted juice.

Regarding the use made of this product in this department, I may say that it is rapidly coming into general favor for all the purposes mentioned above. I have seen it used with complete success in curing what is popularly called here "le noir." This parasitic affliction is not confined to orange, lemon, olive, and other trees, but has been most disastrous to such vegetables as potatoes, beans, pease, tomatoes, etc. I have seen whole rows of orange trees so thickly coated with parasites that every leaf appeared coated with soot (hence the popular appellation "le noir"); and I have been enabled to verify the fact that three or four applications of the lotion have prevented the disease from attacking new leaves and have caused the disappearance of the black deposit upon those attacked. A proprietor of an olive grove here has assured me that the use of the juice in combating "le noir," which has destroyed many thousands of olive trees in this department, is most costly, but at the same time very efficacious.

The spraying machines used to spread the mixture are the same as those employed in applying sulphate of copper to vineyards. I have tried to ascertain whether the use of tobacco juice would not be more desirable in treating vines for the cure of the "oidium"—a parasitic disease of the vine leaves—than sulphate of copper, but I have not found anyone who has experimented with the two treatments. It would appear, at first sight, that tobacco juice would be the better, as sulphate has always been considered a preventive of attacks upon the grapes themselves, especially after the bunches are completely developed, whereas the oidium attacks only the leaves and indirectly the vitality of the plant.

Inland Navigation Project In South America.—Minister Loomis writes from Caracas, under date of June 16, 1899, in regard to a plan recently presented to the government which, says the minister, looks to the construction of the greatest system of inland waterways in the world. It is proposed to connect by means of canals the great river systems of the continent of South America, making a navigable waterway from the valley of the Orinoco to that of La Plata, inclusive. The estimated cost of this work is $200,000,000, which figure, however, is largely conjectural, as no accurate survey or detailed statement of the probable cost has ever been made. It is not unlikely, continues Mr. Loomis, that this matter will be taken up seriously by some of the South American governments within a few years.

Rice Planting in Uruguay.—Minister Finch transmits from Montevideo, under date of May 30, 1899, the following letter published in a local paper, showing the surprising yield of rice in the department of Rivera:

The first planting of rice by Mr. Juan Lemos was 1½ kilogrammes (3·3 pounds) which yielded 150 kilogrammes (331) pounds, a profit of 100 to 1. A sample of the rice has been inspected and is pronounced to be of the best quality. Encouraged by this splendid result, Mr. Lemos will extend his plantations next year. If the enthusiasm for national production spreads, the department of Rivera will, from its soil and climatic conditions, become one of the richest in the country.

Waterworks at Tampico.—The following dated Tampico, July 19, 1899, has been received from Consul Magill:

The governor of the State of Tamaulipas has authorized this city to proceed with the construction of a system of waterworks and sewerage. This report is somewhat in advance of the official city notice, which I presume will outline a plan, but I send it in order that corporations or individuals interested in such contracts may write to me or to their agents in Mexico, to get the details as soon as published.

Coal Trade at Montevideo.—Minister Finch writes from Montevideo, May 30, 1899, that the shipments to Montevideo of coal during the first quarter of the year 1899 amounted to 75,610,672 kilogrammes (74,416 tons).

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 508. August 21.—French Wheat Crop of 1899—Russia's Flax and Hemp Crops of 1898—Aluminum in Great Britain—Competition with American Copper—Germany in 1898—*New City and Port in Northern Russia—Venezuelan Duties on Tobacco—Collection of Customs in Canada—Plague in Persia.

No. 509. August 22.—German Chambers of Commerce—Fruits in Honduras—Contract for Railway in Peru.

No. 510. August 23.—Manufacture and Use of Wood Flour in Europe—*American Horses in Germany—*Street Railways in Frankfort—*Proposed Portuguese Exhibitions in South America.

No. 511. August 24.—Cacao Culture in Ecuador.

No. 512. August 25.—Customs Regulations and Fees in Japan.

No. 513. August 26.—Life Insurance Companies in Germany—*German View of American Agricultural Exports—Report of French Steamship Line—Anchovies in Scandinavia—Salmon Fisheries in Norway—A New Textile Plant.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

How to Grease Shoes.—The mostly employed medium for greasing shoes is fish oil, although it is the worst, for it is, like linseed oil, a drying oil, and the leather remains saturated with it only about one day, afterward becoming hard and brittle again. The best agents are purified lanoline, obtained from animal wool, and yellow vaseline. Both mediums only need to be applied with a rag: they are absorbed entirely in a few minutes, and the leather remains saturated with them for many days, and pliant. These substances are a little dearer than fish oil, but less of them is required, and besides they are odorless and do not injure the most delicate leather.—Gerbercourier.

A factory in which old, rancid butter is worked up into fresh merchandise has recently been started in England, says the Rigaer land- und forstwirthschaftliche Zeitung. The process consists in working the bought-up old butter together with fresh buttermilk until a uniform, semi-liquid mass results, through which a current of hot air is blown. Thereby the volatile butyric acid, which imparts to rancid butter its peculiar smell and taste, is expelled, while any impurities present fall to the bottom. Next, a current of cold air is employed, so that the butter separates into globules. The product thus rejuvenated is now kneaded with water, salted, and, if necessary, colored a little, whereupon it is again put on the market.

An excellent washing agent, which will never attack the linen, is said to be the following:

Caustic soda	150	parts (by weight).
Rosin	75	" "
Scraped white soap	50	" "
Coarsely powdered alum	50	" "
Sodium bicarbonate	290	" "
Silicious alkali	290	" "
Water	600	" "

Bring the water to a boil, dissolve the silicious alkali in it, and gradually add the rosin in small portions. As soon as the solution has taken place, add the remaining substances in rotation. This bleaching agent possesses the advantage, above all things, of not injuring the fiber in the least.—Seifenfabrikant.

Insulating Materials from Fish Oil.—According to E. Andréoli, in L'Electricien, the industry of utilizing fish waste to produce oil originated in France, but has never prospered there. In England the fish waste is utilized, not only fish guano but also insulators being manufactured from the thickened oil which cost next to nothing and possess a considerable commercial value. Constituents of all kinds for dynamo-engines, transformers, switchboards, etc., may be produced from it which give resistance to a tension of 70,000 volts. Pulleys, carriage wheels, saddle pads, and objects of art have been manufactured. These articles, which are made of fiber, saturated with fish oil and treated like similar insulating materials, are said to be superior to vulcan fiber and hard rubber. The cost of production is about $220, and the selling price of this material is about $520. Andréoli has ozonized fish oil for several months, whereby it gained much in color, clearness, and smell. Ozone quickly thickens the oil. It ought not to be difficult to invent a process to imitate caoutchouc by the use of this oil.—Elektrotechnische Zeitschrift.

Cleaning of Waste Waters by the Use of Clay.—If an emulsion of clay is poured into a soap solution, the clay gradually separates out without clarifying the liquid. A few drops of hydrochloric acid, however, being added to a soap solution and a small quantity—about 1·5 per cent.—of a clay emulsion being poured in, the liquid clarifies at once, with formation of a plentiful sediment. Exactly the same process takes place when the waste waters from the combing process in spinning are treated with clay. The waters which remain turbid for several days contain 500 to 800 grammes of fatty substances per cubic meter. If to 1 liter of this liquid 1 gramme of clay is added, with 15 to 20 per cent. of water, the liquid clarifies with separation of a sediment and assumes a golden brown color. Besides the fatty substances, this deposit also contains a certain quantity of nitrogenous bodies. Dried at 100° C., it weighs about 1·6 grammes and contains 30 per cent. of fat. The grease obtained from it is clear, of good quality, and deliquesces at 34° C. After removal of this fat, the mass still contains 1·19 per cent. of nitrogen. The analysis has given the following result: Water, 0·44; organic substances, 0·28; and ash, 0·28. Hence, the clay has absorbed 0·7 gramme of organic substances per liter of waste water.—Schönmann's Journal für Lederindustrie.

Relief Painting on Wood, etc. — Decorator-painter Wilhelm Plinwald, of Stuttgart, has taken out a patent on an invention which admits of producing ornaments in relief on wood or stone as quickly as they can otherwise be drawn or painted. When the priming is done, only a wood-color or a colored glaze, etc., needs to be applied. The new process is carried out as follows: Add to suitably diluted size enough chalk so that the mixture can be dabbed upon the surface to be decorated. The lower ground may consist of any material, wood, stone, gypsum, etc. After six to eight applications and rubbing down or smoothing, a layer of about 5 millimeters in thickness is obtained. The rubbing down is best performed wet, with pumice stone, whereby all air pores are closed up, and a nice smoothness results. Upon the surface thus created an ornament is applied by hand or with a stencil, in moderately thick lines and with not too fat a paint, in order to prevent it from running off. After the drying of the paint, all the uncovered places of the surface are treated with sponge or brush and softened water to which a little potassium bichromate is added. The result will be that the ornament put on with fat paint will remain raised, while everything else is washed away more or less deeply through the treatment. Hence a flat relief ornament is created which, treated with colors after drying, presents a much more favorable effect than the imitations attempted by shading. The bichromate of potassium added to the water penetrates very deeply into the mass, eventually taking away its perviousness to water.—Deutsche Maler Zeitung.

MISCELLANEOUS NOTES.

A curiosity at least is this compilation of the deepest wells in the world: In Europe, one at Passy, France, depth, 2,000 feet; at La Chapelle, Paris, depth, 2,950 feet; at Grenelle, Paris, depth, 1,798 feet; at Neusalwerk, near Minden, depth, 2,288 feet; at Kissingen, Bavaria, depth, 1,787 feet; at Sperenberg, near Berlin, depth, 4,190 feet, which is said to be the deepest in the world; at Pesth, Hungary, depth, 3,182 feet. In the United States there are wells located at St. Louis, depth, 3,843 feet; at Louisville, depth, 2,086 feet; at Columbus, Ohio, depth, 2,775½ feet; and at Charleston, S. C., depth, 1,250 feet.—New York Tribune.

Ornithologists will be interested to learn that measures are being taken under the auspices of the government of Bosnia and Herzegovina to carry out a series of observations concerning the migration of birds. A great number of observatories have been established over a territory extending from 42° 16′ to 51° 10′ north latitude, and comprising coast, plains, mountains, rivers, and lakes; in fact, wherever there was a likely spot for studying and noting bird migration. With a view of similar investigations on uniform principles being instituted in other countries, the government of Bosnia and Herzegovina has convened an international meeting of ornithologists to be held at Serajevo, the capital, on September 25 to 29, when proposals will be brought forward for widening the scope of the Austrian scheme, and elaborating a plan for simultaneous action in regard to research. A very fine collection of birds from the Balkan States will figure among the attractions.

India rubber has long been used in the joints of the doors of side lights in ships to keep these openings watertight. But the expedient does not appear to have been wholly successful, as all travelers in ocean steamers must have observed. A new application of rubber for making ships' doors and windows tight is being put into practice by a shipbuilder on the Clyde. The idea is the insertion in a groove surrounding the opening of a specially strong pneumatic tube, half the diameter of which projects from the framework, and fits into a groove in the door or window. When the door is shut, the tube is fully inflated by automatic action, and the joint is thus rendered airtight and watertight. There is no denying that this will make a perfectly tight joint so long as the tube remains sound and fully inflated, but its collapse by any accident to the tube would be rather inconvenient in an emergency.

The bulletin of the American Iron and Steel Association has received from the manufacturers complete statistics of the production of all kinds of pig iron in the United States in the first half of 1899. The total production of pig iron in that period was 6,289,167 gross tons, against 5,869,703 tons in the first half of 1898 and 5,904,231 tons in the second half. The production of Bessemer pig iron was 3,788,907 gross tons, against 3,703,584 tons in the first half of 1898 and 3,633,800 tons in the second half. The production of basic pig iron, all made with coke or mixed anthracite coal and coke as fuel, was 465,957 gross tons, against 337,485 tons in the first half of 1898 and 447,959 tons in the second half. The production of spiegeleisen and ferromanganese was 104,496 gross tons, against 109,641 tons in the first half of 1898 and 104,128 tons in the second half. The production of charcoal pig iron was 128,485 gross tons, against 147,003 tons in the first half of 1898 and 149,747 tons in the second half. The number of furnaces in blast on June 30, 1899, was 240, against 202 on December 31, 1898. The number out of blast on June 30 was 175, of which several have since been blown in and others are preparing to blow in. The stocks of pig iron which were unsold in the hands of manufacturers or their agents on June 30, 1899, amounted to 81,220 gross tons, against 571,577 tons on June 30, 1898, and 291,233 tons on December 31, 1898.

A new railway in Formosa is to be built by Japan, and the sum of $1,000,000 has been appropriated for this year. Work will be at once commenced at Takow on the Takow-Tainan branch, a line 28 miles in length. The land is quite level, and the work presents no difficulties, except the bridging of two small rivers. The present northern line runs from the Tamsui River in a southerly direction 40 miles to Hsinchiku (Teckcham). It was built by the Chinese and completed in 1893. From the Tamsui River to Twatutia, the foreign settlement, the line runs over nearly-level ground for some 7 miles. It then ascends a table land, on a maximum grade of 3 per cent., and for the rest of the distance, with the exception of a few miles outside of Hsinchiku, it zigzags through the hills on the side of a valley. It has always been unsatisfactory, and portions of the line have been frequently destroyed by storms and freshets. Formerly a bridge across the Tamsui River permitted the trains to run into Twatutia; but this, as well as several bridges a few miles from Hsinchiku, was destroyed during last year's great typhoon, one large iron bridge being carried 260 feet by the force of the wind and current. At present, therefore, the lines do not touch either of the original terminals. The Japanese find that this line must be almost entirely rebuilt. A new bridge nearly 2,000 feet in length and costing some $400,000 will be constructed across the Tamsui River at Twatutia, and the route will follow in a general way the original road, though while passing through the hills it will be on the opposite side of the valley, and by the aid of two tunnels and many cuttings it will be much straighter than the old line. The bridge will be commenced this year and the line probably finished in two years. From Hsinchiku (Teckcham) to Tainan is 145 miles, and it is the intention to build the railway between these two points as soon as the work mentioned above is completed. This line will require numerous and expensive bridges and some 13 tunnels. When completed it will give a railway service from Kelung to Takow, a distance of 205 miles. Mr. Hasegawa is the chief engineer. The chief of the communication department states that in all probability the locomotives, rails, and bridge material will be obtained from the United States. The gage of the present line is 3 feet 6 inches, the rails 36 pounds per yard, and the ten locomotives used are of English and German manufacture. The new locomotives will be heavier than the ones at present employed and the rails will weigh 60 pounds per yard.—Engineering and Mining Journal.

SELECTED FORMULÆ.

A Good Killing Fluid.—After experimenting with a large number of the various killing fluids which have been recommended from time to time, I have always come back to the chrom-acetic acid mixture as giving the most reliable results. Chrom-acetic acid is an excellent fluid for nuclear preservation, especially when the amount of acetic acid is relatively large. It is not so satisfactory for preserving the cytoplasmic structures. In finding a substitute for chromic acid, I have followed up the results of Tellyesniczky, who recommends a mixture of acetic acid and potassium bichromate for preserving the structure of animal cells. After trying several strengths, I believe the following to be the best combination for plant cells: Potassium bichromate, 0·8 gramme; glacial acetic acid, 0·5 cubic centimeter; water, 99 cubic centimeters. This fluid gives excellent results. The objects do not become discolored, but remain clear. The nucleus is nearly, if not altogether, as well preserved as in chrom-acetic acid, while the cytoplasmic structures are usually more satisfactory. Small pieces of tissue, from one-half to three-quarters of a centimeter long, should stay in the fluid from twelve to twenty-four hours. The sections take a good stain, and are especially appropriate for anilin-safranin and gentian-violet, and Haidenhain's iron-alum-hæmatoxylin. Acetic-potassium-bichromate deserves a careful trial, as it will probably prove more satisfactory than chrom-acetic acid.—John H. Schaffner, in Journal of Applied Microscopy.

Bottle Capping Mixture.—1. Soak 7 pounds of good gelatin in 10 ounces of glycerin and 60 ounces of water, then heat over a water bath until dissolved, and add any desired color. Pigments may be used, and various tints can be obtained by the use of anilin colors. The resulting compound should be stored in jars. To apply liquefy the mass and dip the cork and portion of the neck of the bottle into the liquid; it sets very quickly.

2. Dieterich is authority for the following:

Gelatin	1 ounce.
Gum arabic	1 "
Boric acid	20 grains.
Starch	1 ounce.
Water	16 fluid ounces.

Mix the gelatin, gum arabic, and boric acid with 14 fluid ounces of cold water, stir occasionally until the gum is dissolved, heat the mixture to boiling, remove the scum, and strain. Also mix the starch intimately with the remainder of the water, and stir this mixture into the hot gelatin mixture until a uniform product results. As noted above, the composition may be tinted with any suitable dye. Before using it must be softened by the application of heat.

3.

Shellac	3	ounces.
Venice turpentine	1½	"
Boric acid	72	grains.
Powdered talcum	3	ounces.
Ether	6	fluid drachms.
Alcohol	12½	fluid ounces.

Dissolve the shellac, turpentine and boric acid in the mixed alcohol and ether, color with a spirit-soluble dye, and add the talcum. During use the mixture must be agitated frequently.—Pharmaceutical Era.

Fire Extinguishers.—There are quite a number of these formulæ, most of them being solutions of the chlorides and carbonates of the alkaline earths. The following are samples:

Calcium chloride	30	parts.
Magnesium chloride	10	"
Water	60	"

Another has the following formula:

Sodium chloride	20	parts.
Ammonium chloride	9	"
Water	71	"

And still another—

Sodium carbonate	16	parts.
Sodium chloride	64	"
Water	920	"

The most effective of all extinguishers, of which we have any knowledge or practical experience, is ammonia water. It is almost instantaneous in its effect, and a small quantity only is required to be effective in the incipiency of any fire. The vessel containing it should be thrown into the fire in such a way as will insure its breaking.—National Druggist.

Use of Cement Wash for the Protection of Ironwork.—According to La Revue Technique, coatings or coverings of cement have been employed by certain railway companies in France for some years past to protect the metallic portions of bridges crossing their lines from the rapid destruction to which such parts are liable by reason of oxidation, through being continually exposed to the action of clouds of steam and gas, products of combustion escaping from the locomotives.

Formerly the practice was to protect such structures as were most exposed to such deterioration, by providing sheet metal guards, in the form of reversed channels, secured to beams in a direction parallel to the lines, which guards were replaced as soon as they had become worn out. At present, however, iron work in situations where it is exposed to the above deteriorating effects is usually protected by a coating of cement.

A method of applying the cement which is used in Austria, and which is highly spoken of, consists in brushing down the iron-work with a heather broom, dampening it with a rag or whitewash brush, and afterward applying two coats of Portland cement wash made rather thick, and having added to it a proportion of fine sharp sand.

In Berlin a coating of mortar containing a third part of cement has likewise been successfully employed for preserving the parts of ironwork which are buried in the ground.

At Zeebrugge, in Belgium, where a deep-water harbor is now in course of construction, a portion of the pier of 300 meters in length is being formed of open work, and the steel piles of this part are endued with a coating of semi-fluid cement mortar, applied by means of an apparatus worked by compressed air, the piles having been first subjected to a preliminary cleansing by means of a sand blast projected by the same apparatus.

IN KAISER WILHELMLAND.

Of all European South Sea possessions, says the Illustrirte Zeitung, there is perhaps none which is so rarely mentioned in the daily press as the German colony in New Guinea. No wonder—for there are neither uprisings nor Hottentot fights, neither lion hunts nor slave caravans. There is not even a detachment of soldiers, and the war vessel stationed here is chiefly used in coast surveying. Cut off entirely from the world—for the mail steamers come only six times each year—the colonists pass their time at hard work, without an opportunity for romantic adventure.

The colonists are, for the most part, planters, whose lands are clustered about Astrolabe Bay, in the vicinity of Stephansort. On the fertile soil of the region flourish the cocoa palm and the tobacco and cotton plants. The products of the plantations each year are exported in increasing quantities; but the extension of the plantations, the development of the colony, are hampered by the difficulty in procuring laborers. From all parts coolies are brought into the country, so that the population is composed of a motley assembly of many races.

The Chinese and Javanese serve as artisans, gardeners, coachmen, stablemen, cooks, and overseers. Their wives are employed in sorting tobacco. The negroes, the Melanesians and Papuans are, as a general rule, employed only as agricultural laborers, porters, servants, and policemen. They have come to Stephansort seldom for the sake of gain, but merely because they are superfluous in their densely populated native land. Often they show such appreciation for the white man's bread and the opportunity for earning a fixed wage that they extend their three years' contract or settle down with their families.

The Melanesian women, the wives of these coolies and laborers, judged by our standard of beauty, are repulsively ugly. As a rule they have but little grace, and only the youngest girls have that peculiar atmosphere which constitutes a woman's chief charm. The men of the Melanesian race are no more attractive than the women, for their coarse features are disfigured by tattoo marks. Despite their apparent barbarity, these savages are not without a certain amount of intelligence. Many of them make good soldiers and sailors. The wild old fellow pictured in Fig. 8 is a native of Neu Pommern, sentenced to hard labor for inciting his companions to desertion.

Ethnologically related to the Melanesians, but different from them both in general appearance and disposition, are the Papuan laborers, recruited from Huon Gulf and Berlinhafen. Most remarkable are their Jewish features and their peculiar hair-dress, to which they owe their name; for "papuawah" in the tongue of the Malays signifies "curly head." From the custom of the native village, the age and the personal taste of each savage arise many forms of hair-dress, which, to our eyes, are most ludicrous. Of these customs the most remarkable is found at Huon Gulf. If a Papuan lose his wife, he incloses his woolly crop of hair in a stiff piece of bark rolled into the form of the well-known "stovepipe" hat. This headgear he wears for the space of a year. In Fig. 3, two such bereaved widowers are illustrated.

In strong constrast to these imported laborers stand the aborigines, who live from their surplus agricultural products and by barter, and who cannot be induced to work. They, too, belong to the Papuans. Before the coming of the Europeans, their civilization was that of the stone age.

A most favorable influence has been exercised over the people by the missionaries stationed in Kaiser Wilhelmland. The general contentment and friendliness of the natives is to be attributed largely to their exertions.

Let us now proceed to Lalu, one of the four communities which constitute the village of Bogadjum. It is evening, and the families are returning from their work on the plantations. Before the houses women and children are preparing the yams and taro that form the evening meal. Bananas and cocoanuts are side dishes; fish are delicacies, and roasts—provided by the household pigs and dogs—are eaten only at great feasts. From the neighboring village of Gavrimah there comes a young woman clad in an apron of sago palm leaves, her neck ornamented with shells, dog-teeth and pearls. On her hip she carries a child (Fig. 7). From the hamlet of Bongu there has also come a young man, who lodges in the "dasâm," the public house which in every community serves as an assembly and council hall. In the "dasâm" of Lalu is preserved a peculiar treasure—a grotesque wooden figure, which bears the marks of having been hewn with stone tools. In compliance with our request a young man brings forth this strange figure from its concealment, and shows, from the carelessness with which he handles it, that it is not an idol, but the statue of some ancestor. Returning now to the seashore, we come upon a large sailing canoe, upon which is built a hut-like structure. The canoe has come from the neighboring island of Bilibili, laden with pottery; for the Bilibili natives are bold sailors, who even venture as far as Dampier Island, a spot sparsely populated by a poor people, many of whom build their huts in trees whose branches overhang the water. The natives of Dampier Island make the hollow wooden drums (Fig. 12), which are much sought after by the inhabitants of Stephansort.

Thus every village, every island, has its peculiarities, and the longer we seek them, the more of them we find. The civilized man, after all, takes a certain interest in his "wild" fellow creature, and the singularities of our wild colored brethren of New Guinea are by no means few.

In Figs. 10 and 14 we present two excellent specimens from the Papuan animal and vegetable kingdoms. The snake represented is a rare reptile, two meters in length, grass-green in color, spotted with white and yellow. The natives consider this snake venomous, but no naturalist has yet determined its zoological position or given it a name.

In Fig. 14 a most characteristic group of trees is

Fig. 1.—MELANESIAN WOMAN EMPLOYED BY THE NEW GUINEA COMPANY.

Fig. 2.—MELANESIAN WOMAN.

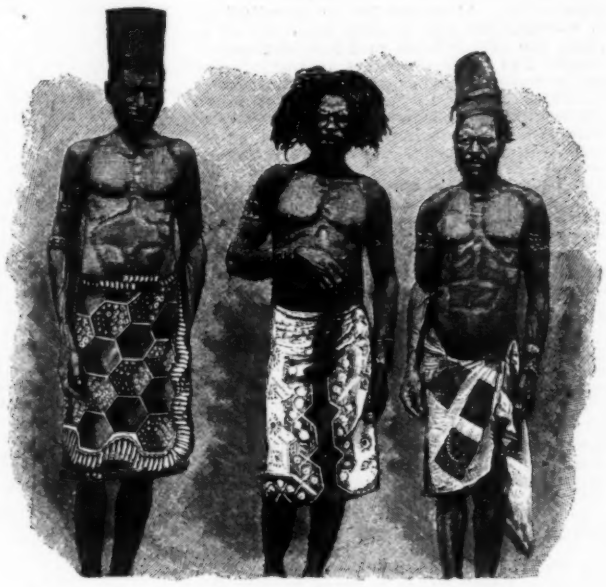


Fig. 3.—HUON GULF LABORERS.

Fig. 4.—JAVANESE AND MELANESIAN WOMEN EMPLOYED ON A STEPHANSORT PLANTATION.

Fig. 5.—A YOUNG MELANESIAN GIRL.

pictured. The trees are over fifty feet in height, have many thick, short, aerial roots, and grow in marshy ground. The trunks are often a foot in diameter, and, like the roots, have long, tough fibers.

THE ELEPHANT OF CATANIA.

THE diligence of Prof. Holm has brought to light one or two scraps both of Byzantine and of Saracenic work

FIG. 7.—A WOMAN AND CHILD FROM GAVRIMAH.

lurking in the streets and lanes of Catania. But no Byzantine or Saracenic building remains. There is however one work of art which, if we can believe the local legend, belongs to the days of Byzantine rule, but which by no means comes within the standard of Byzantine orthodoxy. The elephant wrought in lava, with tusks of white marble, which in later times has been set to carry an Egyptian obelisk in the place before the cathedral, is held in local belief to be the work of a certain Diotro, Diodoros, Liodorus, or Heliodoros. But this Sicilian forerunner of Lord George Gordon was a mighty necromancer indeed. He turned men into beasts, and when he was carried to Constantinople to die for his crimes, he escaped the vigilance of the imperial police by flying through the air back to his own city. But there he met with his match in the Bishop Leo of Ravenna, who, as himself a worker of wonders through holier influences, bore the surname of Thaumatourgos. Heliodoros, once it is said a candidate for the bishopric, was burned, not indeed in Ætna, but in some lowlier furnace of fire. The modern historian of the Sicilian Mussulmans sees in this tale a legendary account of the last destruction of heathen monuments by Christian hands. But the elephant, whatever may be his date, is there to speak for himself not only in his own person but in the place which he bears in the arms of the city. The obelisk which he has borne for the last 150 years has no natural connection with its bearer, nor is it obvious why an Egyptian work should find itself among the ornaments of the Sicilian city. An explanation has been found in the fact that Agathokles had an Egyptian wife, Theoxena, who it has been guessed was the stepdaughter of the first Ptolemy. Agathokles may have received an obelisk as part of her dowry, and he may have set it up at Catania. At any rate, the work of the Egyptian is there, mounted on what passes for the work of the convert to the creed of the Hebrew.—The Architect.

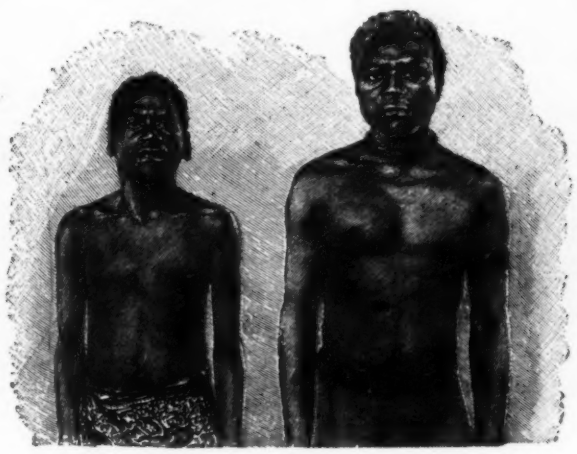


FIG. 6.—MELANESIANS.

THE DISCOVERY OF THE AGORA AT CORINTH.

SINCE I described, somewhat more than a year ago, in these columns the discovery of Pirene, the excavations at Corinth have yielded another important result, which makes it permissible, if not desirable, that this truly American work, which is going on so far away from the eyes of most Americans, should be trumpeted out a little at home. When I look back on the results of three excavation campaigns of from two to three months each, I am filled with wonder that we have been able to accomplish so much.

In the year 1895, when the excavations of the American School, conducted by Dr. Waldstein at the Argive Heræum, had come to a close, the managing committee of the school, through its chairman, asked me what excavation enterprise I had to propose, assuring me that whatever selection I made would be supported to the extent of the resources which the school had at its disposition. To this question I replied promptly. For more than a year I had had Corinth in my mind. I had felt that the time had come for the excavation of a large Greek city, which up to that time had not been attempted. Corinth afforded an opportunity to make this beginning, because the prosperous town that covered a good deal of the site of the ancient city had been wiped out by the earthquake of 1859. And yet I was appalled at the magnitude of the undertaking. The area of the old city was well known from traces of the ancient wall: but within this area, at the foot of the imposing Acro-Corinth, extending about a mile from north to south and nearly two miles from east to west, not one point of ancient Corinth was identified. There was, to be sure, a probability that one might strike something almost anywhere; but that one would miss the important things was vastly more likely. That one should hit the bull's-eye without some sort of suggestion was the most unlikely thing of all. A Greek ephor, M. Skias, had in 1890 made one attempt to find the Agora, resting upon a theory which he had formed in regard to its location—an attempt which had only a negative

FIG. 8.—AN OLD NATIVE OF NEU POMMERN.

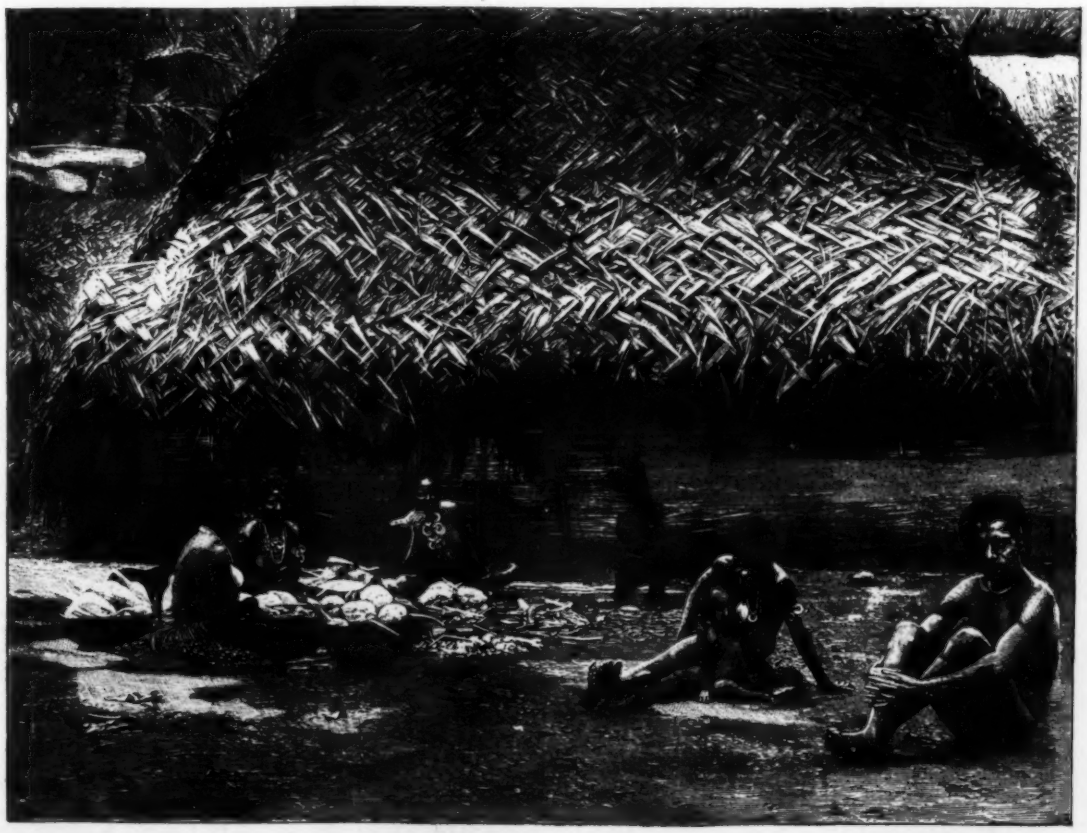


FIG. 9.—LALU WOMEN PEELING EDIBLE TUBERS.

who in the eighth century turned Jew, practiced magic and became a manufacturer of idols. The Jews of Catania were a numerous and proselytizing body in the days of Gregory the Great; but, whatever may have been their misdeeds, it is hard to charge either them or the Saracens with being makers or worshipers of idols.

result. M. Skias came to the conclusion that very little of the Greek city would ever be brought to light. Feeling the uncertainty of any immediate results of excavations in this great area, I had for a time turned my attention to the Argos, which affords a little strip of free ground, at the foot of its acropolis, while the rest of the ancient city is largely covered by the modern city of ten thousand inhabitants. But there was some difficulty in securing that particular area in Argos, and I had already reverted to Corinth when I was called upon to make my selection.

In order, however, to have two strings to my bow, I secured from the representative of the Greek government in archæological matters the concession not only of Corinth, but also of Sicyon, where the school had already rendered conspicuous service in excavating the theater. Prof. B. I. Wheeler, my colleague for that year, then visited with me both sites, in order that, as he expressed it, "we might not be talking through our hats" in answering the committee. As he concurred with me in the belief that Sicyon offered no essential encouragements which the more important neighbor city did not also afford, Corinth was the choice.

In the spring of 1896 we took the field and dug more than twenty trial trenches, spread out over a wide area, but most of them in or near the wretched hamlet which goes by the name of Old Corinth, with the hope of finding out where to strike in earnest. It was only after this stage was reached that we could ask the Greek government to step in and expropriate the land. Although we found much that was of interest, particularly vases of all ages, in several of these trenches, it was not until near the end of the three months' work that we gained partially, at least, our object. In trench xviii we found, as we had hoped, the theater. This was buried under from fifteen to twenty feet of earth and badly broken up. So, after digging branches and supplements to our main trench until we got up to xviii f, we left it unexcavated, and so it lies to-day. Prof. Babbitt, however, made a plan of it, accompanied by a full description.

But the importance of the theater lay in the fact that it gave us the first identified point. Pausanias has a fairly full and fairly clear description of Corinth; and, having secured one point, we were on his track. Had we had a second point, we could at once have drawn a line and placed most of the monuments which we have now found. Had the name of the venerable temple ruin, by which Corinth has long been known to travelers, been known to us, we should even then have had this line. It is true that I guessed its name and recorded my guess in the report of this first year's work.

In a trench dug in a valley just east of this temple, we found at a depth of about twenty feet a broad pavement, which, combined with the configuration of the soil, made me think that the Agora was near. To find the Agora was to solve the topography of Corinth, because Pausanias, after describing what is inside the Agora, proceeds out from it, describing monuments right and left along the main streets.

I can never adequately set forth the impatience with which I waited for the opportunity to put my guesses to the test of another excavation campaign. When the time came around to begin, the campaign dropped out on account of the war between Greece and Turkey; and two years of waiting increased my eagerness to a fever. In the work of 1898, proceeding up the valley east of the temple, we found buried under thirty feet of earth Pirene, the most famous fountain of Greece, with its architecture (a two-story façade) almost intact, except for the loss of its marble facing. There was much else in the work of that year that was interesting—public attention was especially drawn to the inscription from the synagogue in which St. Paul preached; but the main result was Pirene. If we had found but two stones of it, it would have been important, because it was our second point; and now we had our line. It was the same as if we had the Agora. We could now point in a certain direction and say, "There is the Agora;" but we could not tell quite how far away it was. But a broad marble staircase, thirty steps of which we laid bare, leading from the broad pavement before mentioned up the valley lengthwise, toward where it ended in a broad level space, led us to think that it was near. How very near we little knew. The campaign came to an end without the complete uncovering of Pirene.

This year I began the campaign with just as much interest, but no feverish eagerness. The finding of the Agora was now simply a question of time. I had outlined to the committee, as the work of this campaign, the completing the excavation of Pirene, the excavation of the temple, and the proceeding toward the Agora as far as the money held out. The three movements we carried on at the same time.

When we began to proceed up the marble staircase which led up the valley we found that we were already at the top, and almost immediately we found the foundations of the propylæa, mentioned by Pausanias, through which the street to Lechæon, the harbor of Corinth on the Corinthian Gulf, passed out of the Agora. From the mere mention of Pausanias one would have no idea of the magnificent position of this gateway, looking down the valley, challenging the gaze, the observed of all observers. It was what we were looking for; but it came so suddenly that I did not dare to believe in our good fortune, nor did I announce it until the end of the campaign, when we had gone a long way through the propylæa and cleared a considerable portion of the Agora itself.

Two important results followed. The "Old Temple" became at once and for all time the Apollo Temple, because it lies just where Pausanias puts the Apollo Temple. Then the huge, rough-hewn block of native rock just west of the temple was found to be a fountain, at the time dried up, with only about a third of its height protruding from the ground. Not until we had cleared it out to the bottom could we be sure that it was a fountain house; and then we knew from its position that it was the fountain Glauke, called after the unfortunate princess of that name, the wife of Jason, who threw herself into it to escape the fiery poison given her by Medea, who, if she could not have Jason, would destroy all that belonged to him.

All the results of our work will appear as heretofore in The American Journal of Archæology. The story need not be made complete here. In brief, in three campaigns we proceeded straight to the goal. The two touchdowns were the theater and Pirene; the goal was the Agora. Before the close of our work this year, one who is universally recognized as a leader in the archæological world said in public: "Since the excavations of the American School we have a topography of Corinth. Before all was conjecture and confusion." These conjectures, to some of which great names were attached, were, of course, mutually contradictory, and most of them now seem ridiculous. One who has gone below the surface and found the bottom facts is privileged to smile at the great guessers of the past, and appropriate the words which Metternich used of his companions in statecraft: "My God! how wrong they are, and how right I am."

Without the aid of several generous donors, this work, which has cost about $3,000 a year, could not have been carried on. The school, which is doing a fine work in quickening classical learning, is barely self-supporting. Excavating, which is that part of its activity which arouses most interest in Greece, and probably elsewhere, has to be paid for by a few willing friends. May these never grow less, but more! A buried city, and a famous one, is being brought to light by our American School. While Germany is laying bare Miletus, and Austria Ephesus, we ought to keep pace with them at Corinth.—Rufus B. Richardson, in The Nation.

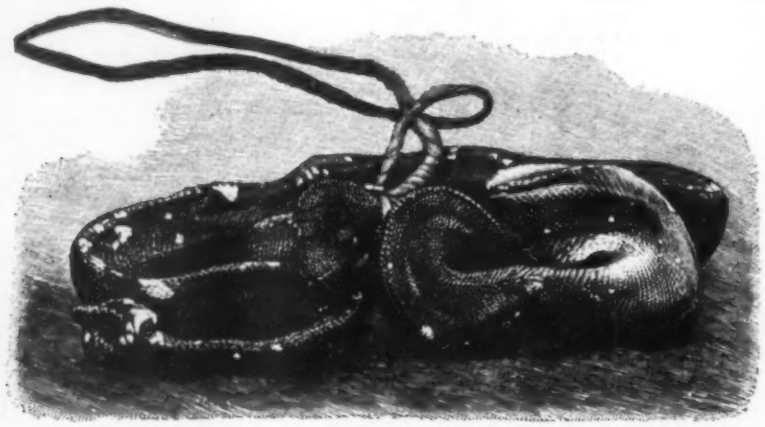


FIG. 10.—A NEW GUINEA TREE-SNAKE.

FIG. 11.—A NATIVE OF BONGU.

FIG. 12.—NATIVES OF DAMPIER ISLAND.

FIG. 13.—AN ANCESTRAL STATUE IN LALU.

THE ROMANS' KNOWLEDGE OF THE CHINESE.

THE Greeks and Romans had but a vague knowledge of China. It was to them the silk-producing country, somewhere in the far East; but with the exception of one author, Pausanias, their writers were actually unaware that silk was the product of a caterpillar. It appears that the Parthians were the intermediaries in the silk trade; and in their desire to keep this traffic in their hands, they discouraged communication between the East and West. The ordinary name given by the Romans to the Chinese, namely, the Seres, is supposed to come from the Chinese word for silk. The other ancient term for them, the Sinæ, seems to have reached Europe by way of the Malay Islands and India; and the Sinæ were wrongly believed to be a different nation from the Seres, living more to the south. A third title by which China has been known in Europe, namely, Cathay, is much more recent, and belongs to mediæval times. It came to us through Persia, and is derived from the Ki-tai or Ki-tans, a Tartar race who subjugated North China and ruled there from 907 to 1168 A. D.

Let us now look at the Chinese side. About 70 A. D. was one of the prosperous periods, when China attained its greatest expansion. Its armies then traversed Central Asia and reached the shores of the Caspian. In these distant expeditions they heard of the Romans, of whom they speak in the highest terms. The Romans are described in Chinese books of those days as simple and upright, and as never having two

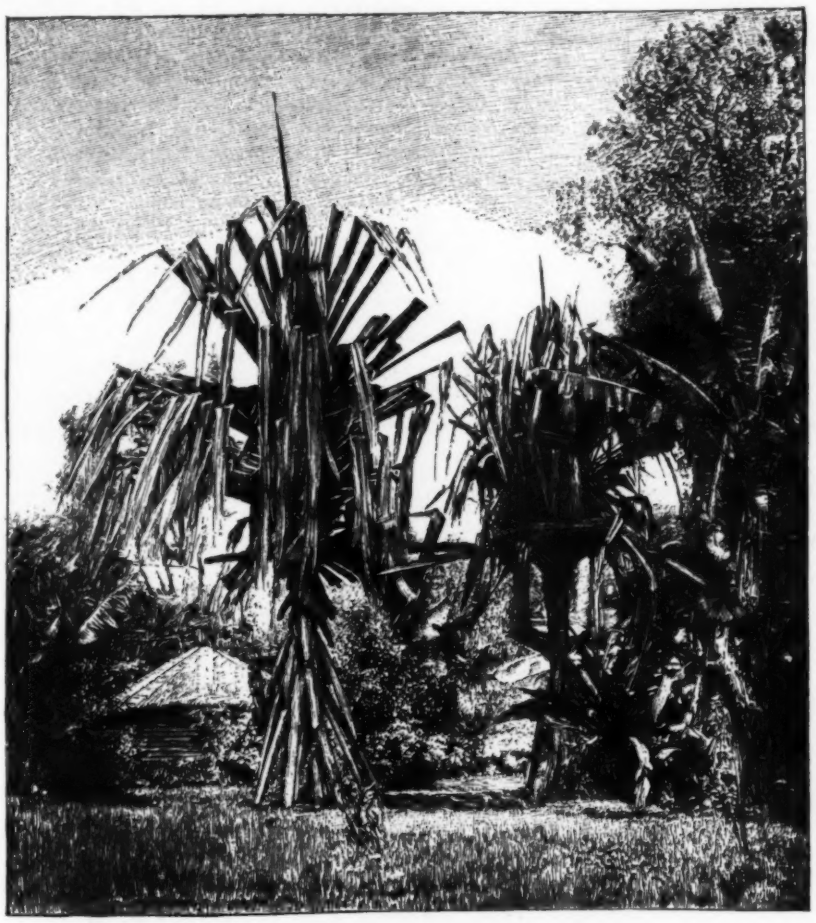


FIG. 14.—A GROUP OF PAPUAN TREES.

FIG. 15.—TREE HUTS ON DAMPIER ISLAND.

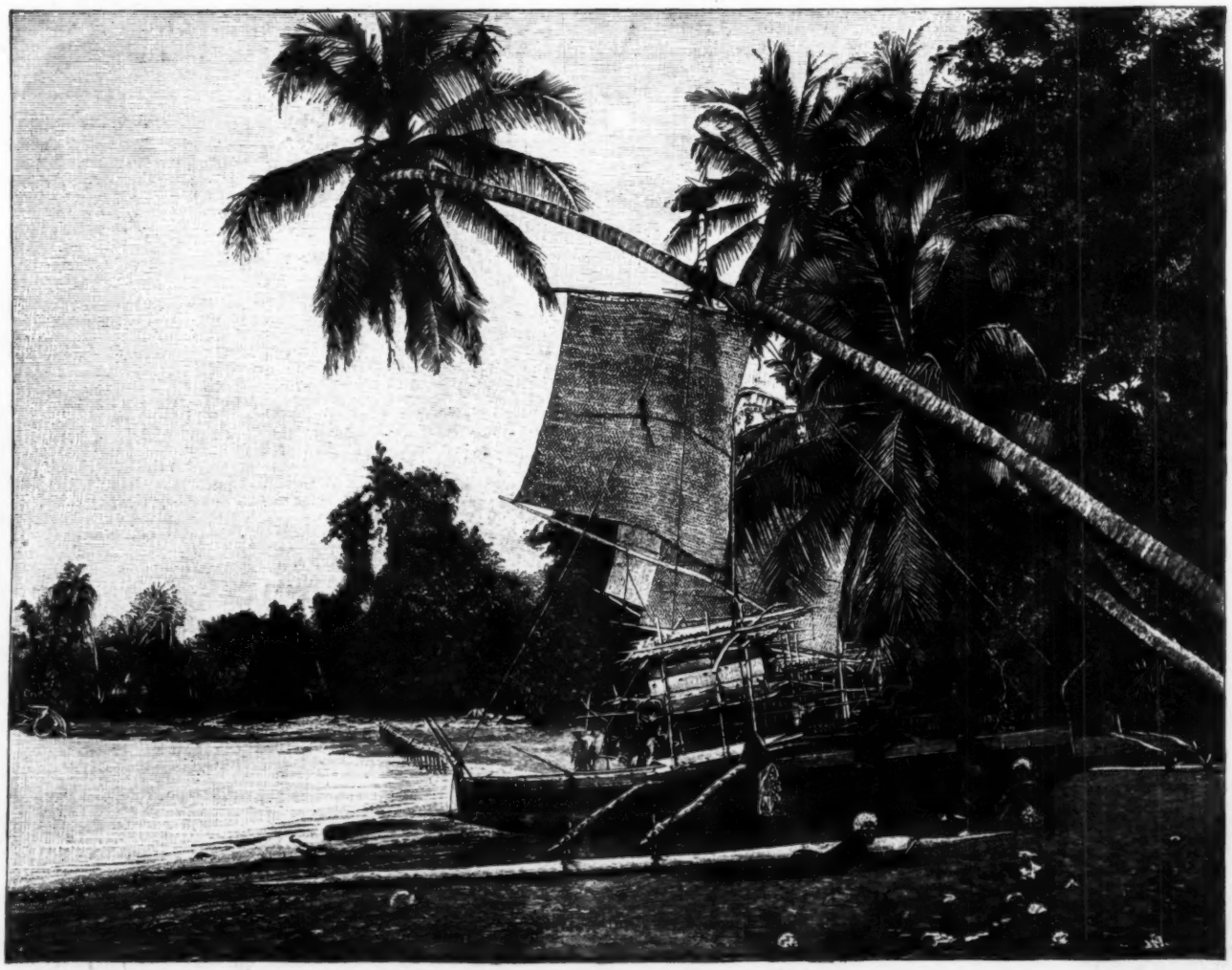


FIG. 16.—SAILING-CANOE FROM BILIBILI.

prices for their goods. Everything precious and admirable in other countries comes from their land. Ambassadors to their government are provided by them with carriages and furnished with money for their expenses. The Chinese called the Roman Empire by the name of Ta-tsin, of which term no satisfactory explanation has yet been suggested. Their knowledge of the Roman world at that time was not very accurate, as may be seen from the fact that they thought Antioch was the capital of the empire. But as this city was the seat of the proconsul who governed the Oriental provinces, the mistake was not unnatural.

A few centuries later a Chinese work notes that Tatsin (i. e. Rome) is now called fulin. It is generally believed that this fulin was the Greek πόλιν, and referred to Constantinople. There is no mention of any embassy sent from China to Rome, except that the Roman poet Florus enumerates the Seres among those whose ambassadors came with presents to Augustus. But it is generally held that the poet was incorrect in saying this. On the other hand, the Chinese record—and the statement seems to meet with full acceptance—that in 166 A. D. an embassy arrived by sea from the Emperor Marcus Aurelius, whom they style An-tun—i. e. Antoninus. It is a most curious fact that this embassy was dispatched at all, and still more so that it came by the way of the Indian Ocean, and entered China from the south. Details are given concerning the embassy. The gifts which it brought—apparently articles from the tropical East—are noticed as being of little value.—Asiatic Quarterly Review.

THE LION AND THE BULL.

AT three o'clock in the afternoon of July 17 the arena of Roubaix was lined with more than 12,000 persons. Here were Parisians who had come by special train, Englishmen, Belgians, and especially Roubaisians. This assemblage had paid $20 for boxes and $8 and $4 respectively for what are called "barriere" and "centre-barriere" seats. The gate receipts amounted to more than $24,000.

Did not the spectacle announced comprise a number worthy of the Roman circuses—a fight of the lion Goliath ("captured in Abyssinia on the seventh of last January and never yet conquered") with the bull Venaito, "of the best Spanish breed"? The greedy crowd, unconscionably cruel, awaited this rencontre with a visibly enervated feeling.

Three classic races occurred in the first place. Then three bulls were correctly put to death, the last by Don Luis Mazzantini, who is at present retired from the arena and is simply artistic director of the fête. Called for with loud cries by the assemblage, he gallantly came forward and, clad wholly in gray and bareheaded, deigned to give the fatigued beast the final stab.

After he had been applauded, every eye was turned toward the huge 25 by 55-foot cage that is installed against the torii and occupies nearly a quarter of the ring. Into this the lion now made his entry through a sliding wicket. He was received with an uproar, but was indifferent and tranquil, and at once began that backward and forward promenade that is the sole exercise permitted to menagerie lions.

A minute elapsed, the wicket went up, and the bull appeared in his turn. Hesitating but a moment under the light, he perceived the lion, made a sudden rush, and ripped open the sides of the surprised enemy with his horns. Goliath made a parry with his paw as he might have done at a blow from the trainer's whip; but he immediately submitted, turned his back upon the bull, and again began his slow promenade.

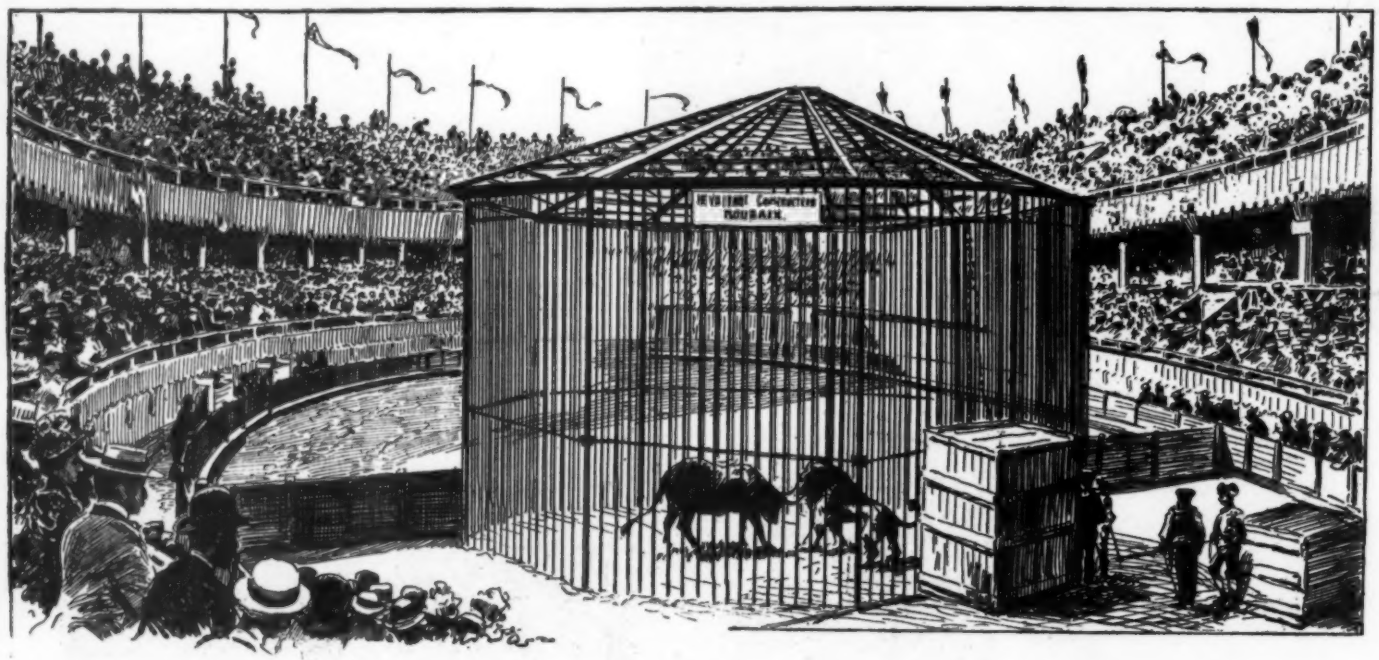
The bull returned to the charge, but the lion fled and endeavored to climb up the bars of the cage. The contest was evidently unequal. The bull was alert and combative, while the lion acted as if under the influence of a narcotic, and desired only to be left in peace. Why should he fight? He was not famished. He had had his ration of horse meat on the preceding day, and, perhaps, on that very morning. The hour for his evening meal would soon arrive. What would be the good, with his muscles weakened by captivity and unexercised for a long time, of attacking this strong and furious beast with brutal horns as sharp as a pitchfork? The lion roared his discontent and then his distress. The bull was enraged and his horns were red.

The spectacle was poignant and also pitiful. The spectators stamped. Instead of the fight that had been promised them, an almost repugnant exhibition had been offered. Some of them entered the ring, and one person struck the lion through the grating with a sword cane; it was the kick of the ass's foot!

People cried "Enough! enough!" The bull was then turned out of the cage and was afterward put to death in the arena after the usual exercises and under the eyes of the lion in his death rattle.

As a result of this duel of two animals, one of which did not wish to fight, a discontented Roubaisian sued the organizers for two dollars, the price he paid for admission; the celebrated tamer Bidel demanded compensation for the lion; and the government is, it is said, to forbid any further spectacles of this kind.

For the above particulars and the engraving we are indebted to L'Illustration.



THE ARENA OF ROUBAIX DURING THE FIGHT OF THE LION AND BULL.

SOUTH AMERICAN TRADE.

THE commerce of the countries lying south of the United States and the share of the various nations therein are discussed in considerable detail in the June Summary of Commerce and Finance, just issued by the Treasury Bureau of Statistics. The commerce of the United States with the American countries lying south of her borders has long been an object of solicitude to her statesmen, economists, and business men. With the English-speaking people of American territory lying upon the north her commercial relations have rapidly grown and proved mutually satisfactory. With those of another language, occupying contiguous territory at the south, the growth has been slower and less satisfactory, and as the distance increases, the growth decreases. To British North America the United States supplies 59 per cent. of the total imports for consumption; to Mexico, equally adjacent, but speaking another language than our own, 49 per cent.; to the Central American States, next removed by distance, though readily reached by water and now being tapped by railways, 37 per cent.; to Colombia, a trifle farther removed, but equally accessible by direct water transportation, 33 per cent.; to Venezuela, equally accessible, 27 per cent.; to the West Indies, which lie in close proximity, but which have been up to the present time controlled by commercial nations whose policy in many cases has been to retain their commerce for their own people, 20 per cent.; to the Guianas, also readily reached by water, 25 per cent. of the imports into British Guiana, 17 per cent. of those of Dutch Guiana, and but less than 6 per cent. of those of French Guiana.

Up to this point the study of the growth of commerce between the United States and other American countries is fairly satisfactory. Beginning with 59 per cent. of the import trade of Canada, 49 per cent. of that of Mexico, and ranging on downward along the Gulf of Mexico and the Caribbean Sea, a fairly satisfactory share of the commerce of those countries is enjoyed by the people of the United States; though it will be conceded that her people have a right to expect a larger share of the commerce of the countries lying so near at hand, especially in view of the fact that our purchases from them are much larger than our sales to them.

Even this somewhat unsatisfactory condition of trade with the countries bordering upon the Gulf of Mexico and the Caribbean Sea is, however, gratifying when compared with the trade relations of the United States with the countries of South America bordering upon the Atlantic and Pacific Oceans. Of the total imports of all South America, 87 per cent. is taken by the countries bordering upon the two oceans, and but 13 per cent. by those bordering upon the Caribbean. Marching down the eastern coast of South America, we find Brazil importing, in 1897, goods to the value of over $105,000,000, of which the United States supplied about 12 per cent.; Uruguay and Paraguay $22,000,000, of which our share was less than 7 per cent.; and Argentina $95,000,000, of which less than 7 per cent. was from the United States; while a tour of the Pacific coast shows importations into Chile of $24,000,000; Peru, $8,500,000; Bolivia, $11,600,000; and Ecuador, $7,000,000, the proportion from the United States averaging about 10 per cent. Thus the northern coast of South America, fronting on the Caribbean Sea, imports goods to the value of $36,000,000; of which we supply an average of 25 per cent.; the eastern coast, fronting on the Atlantic, $222,000,000; and the Pacific coast, $51,000,000, of which our proportion is in each case about 10 per cent.

Nor can it be urged that this condition is a temporary one. While exports from the United States to Mexico have grown rapidly, especially since the opening of railway communication, and have experienced a moderate development in the case of the countries bordering upon the Caribbean Sea, the total sales to the countries south of us have not grown with the rapidity which has characterized those to the world at large. In 1868 our sales to the American countries at the south were 20 per cent. of our total exports; in 1878, a little less than 10 per cent.; in 1888, a fraction above 10 per cent.; and in 1898, but 7 per cent. of our total exports.

An examination of our list of purchases from the Central and South American countries seems to increase the anomaly presented by their small purchases from us. Of Brazil, we are by far the largest single customer in her chief articles of export, coffee and rubber; while from Argentina and Chile our purchases of wool and hides are also heavy, and for the tropical products of the other countries of South America—sugar, spices, fruits, dye woods, cabinet woods, textiles, and chemicals—the United States offers a constant and rapidly increasing market. From the South American countries fronting upon the Atlantic and Pacific the United States in 1897 purchased goods valued at $88,408,119, while her sales to them in that year were but $24,480,013, or less than one-third of her purchases from them; in 1898, despite the fact that to the whole world our sales were double the amount of our purchases, those to the South American countries beyond the Caribbean Sea were still but about one-third of the amount of our purchases from them.

A study of the map of the world, and especially that which shows the relation of South America to the United States and Europe, seems to offer a partial explanation of the anomalous conditions with reference to the trade of all the countries lying south of the easternmost point of South America and stretching up its westerly coast. The commerce of the world reaching Brazil (south of the Amazon), Uruguay, Paraguay, and Argentina on the Atlantic coast; and Chile, Peru, Ecuador, and the interior state of Bolivia, on the west, must reach them by water, and their sales to other parts of the world must also go by water. An examination of the map and routes of steamships, the sole vehicles of transportation for these countries, shows that the markets of Europe are practically as near to all of South America fronting on the Atlantic and Pacific as are those of the United States. The easternmost point of South America extends 2,600 miles farther east than New York, and the sailing distance from that point to New York is actually greater than that to the cities of Southern Europe and but slightly less than to the principal commercial cities of England and Germany, our greatest commercial rivals. This fact of itself would place the United States upon practically an equal footing with Europe in the matter of proximity alone; but when it is considered that nearly all of the steamship lines entering South American ports are controlled by European capital and European interests, it is not surprising that a large share of their commerce should be diverted to Europe. Naturally a considerable share of their exports goes direct to Europe, and to that extent it would be quite reasonable to expect that their purchases would be from that part of the world.

The fact that the exports from the United States to Europe greatly exceed the imports from Europe makes it practicable for the vessels which bring the rubber, coffee, hides and wool of South America to the United States to readily load at our ports with grain or provisions for Europe and there load again with goods for the South American markets, thus making the tour of the triangle, of which the line from New York to Liverpool forms the base and the ports of Brazil and Argentina the apex. That this should occur under ordinary conditions is not surprising, and that it should occur with lines of steamships controlled almost exclusively in the interests of Eu-

ropean capital and trade is to be expected. Added to this is the lack of banking and business facilities for direct intercommunication with the United States, neglect of American merchants to closely study the trade methods and requirements of the countries in question, the absence of direct solicitation of trade relationship and in the language of the country where business is sought, all of which are valuable aids in increasing our sales to the countries in question.

That closer, more frequent and direct steamship communication is an important factor in obtaining the commerce of countries which can be reached only by steamship lines is evidenced by the more rapid growth of our exports to the countries fronting upon the Caribbean Sea, with which fairly satisfactory steamship connections now exist, and suggests the advantages which may be expected to accrue to our trade with at least the western coast of South America when an isthmian canal shall place Ecuador, Peru, Bolivia, and Chile in as direct communication with ports of the United States as those fronting on the Caribbean now possess. With a steamship route to western South America by way of the isthmus, the completion of the trans-Andean road connecting western South America at Valparaiso with eastern South America at Buenos Ayres and Montevideo, and increased steamship facilities between our ports and those of both coasts of South America, the manufacturers and producers of the United States may reasonably expect to increase their sales in those markets, to which their annual exports are now but about one-third of their annual imports from them.

One possible, if not probable, development of the near future in certain sections of Central and South America is worthy of consideration, and especially so with reference to the proposed intercontinental railway, since it relates especially to the regions which that line would invade. The possibility of utilizing, with the assistance of modern electrical methods, the enormous quantity of water power now going to waste in the mountain regions of Central America and northern South America is worthy of attention in considering the future possibilities of that section of the continent. The trade winds, sweeping westward across the Atlantic in the equatorial regions, become heavily charged with moisture evaporated from the ocean by the extreme heat of the sun, and striking the mountain chain stretching southward through Mexico, Central and South America, are forced upward to a cooler atmosphere, where the moisture is condensed into heavy rainfalls, thus feeding the mountain streams and rendering them capable of developing power in great and almost unmeasured quantities. With the facilities which modern electrical methods supply of utilizing, controlling and conveying this power, the development of mining, mechanical, and manufacturing industries in that region, where nature is so lavish in her supplies and producing possibilities, may be very great within the near future, and especially so when access shall be obtained by the proposed railway lines, which, if present plans are realized, will invade this very section and with lateral lines bring it into communication with the sea.

TOBACCO CULTIVATION IN ITALY.

THE province of Lecce has for a long time past been considered as peculiarly indicated from the character of the soil, as well as its climate, for the cultivation of tobacco, and rightly so, as good quality leaves are certainly produced, and the so-called "Lecce" snuff, which is sold in small drums, not unlike a diminutive Smyrna fig drum, has long been favorably known to snufftakers. Consul Cocoto in his last report states that under the preceding governments the cultivation of tobacco was almost free of restriction, but since Italy has become a first-class power the production and sale alike of salt and tobacco has become a government monopoly, with the result that the plant is grown only under certain restrictions and with the constant surveillance of the government department to which the monopoly is attached.

The enormous increase of late years in the use of the cigarette has rendered it necessary for the monopoly to provide this article in its various varieties in constantly increasing quantities, and some few years back efforts were made to cultivate the form of the tobacco plant grown mostly in Turkey. With this end in view the department sent a quantity of seedling plants to Lecce for experimental purposes, and as the experiment gave favorable results, the plant has been gradually introduced in substitution for other qualities which were formerly grown in the district. It appears that one of the principal conditions of success in the growing of this delicate quality of tobacco is that the land be exclusively manured with ovine matter, and on landowners it was specially enjoined that none but sheep dung should be used by them in the cultivation of the "Oriental" tobacco plants confided to them by the department.

The result of the crop has, it appears, been disappointing; cigarettes made from the leaves grown in the province of Lecce have proved defective, the tobacco was not aromatic, and would not keep in some cases, which the department attributed to insufficient manuring, or the total absence of manuring, while in the case of other parcels, the smell was altogether offensive, which was attributed to the plants having been manured with ordinary farm manure, and not the special manure indicated by the department. Matters have been brought to a head by the department announcing that unless landowners fulfill the conditions imposed on them when accepting the cultivation of the plant for account of the government, it will be necessary to discontinue the cultivation of the Oriental tobaccos in the province.

The president of the Chamber of Commerce recently called a meeting, at the county town of Lecce, of the various landowners interested in the cultivation in question, and, after a long discussion, on the proposal of the mayor of Lecce, a memorial was unanimously adopted by the meeting, attributing the bad results complained of by the department to the fact that the price which the producer receives from the department when grown rendered it quite impossible for ovine manure to be exclusively used, inasmuch as the manure in question was not obtainable in any quantity, there being no inducement held out to rear sheep in the district. The meeting further deliberated that the extension of land now admitted to tobacco cultivation be increased, the prices paid be increased, the classification of the produce to be less rigorous, particularly as regards the "Oriental" qualities, and that the government institute an ambulatory professorship to further instruct growers as to the best means of growing the tobacco plant. This incident is of recent occurrence, and the result is so far unknown. Consul Cocoto says that it is to be hoped that a compromise of some kind will be arrived at, so that the province shall not lose this most important industry.—Journal of the Society of Arts.

NEPENTHES BALFOURIANA ×.

THIS very handsome Nepenthes formed part of the remarkable exhibit made by Messrs. James Veitch & Sons at the recent Hybridization Conference. Messrs. Veitch, as is well known to our readers, have achieved many successes in hybridizing Nepenthes, the species of which lend themselves readily to the gardener's art. The present pitcher is the outcome of a cross between N. mixta ×, Mast., and N. Mastersiana ×, Veitch; N. mixta, Mast., is itself a hybrid between N. Curtisii and N. Northiana, Hook. f., and N. Mastersiana × is the result of a cross between N. sanguinea and N. Khasyana—so that the present plant is the descendant of four distinct species.—Gardeners' Chronicle.

NEPENTHES BALFOURIANA ×: HORT. VEITCH.

DISTILLED WATER AS A BEVERAGE.

THE following practical editorial remarks appear in The American Kitchen Magazine for July:

"There is a difference between a beverage and a medicine, and while no one will dispute the fact that there are many cases in which the use of distilled water by a physician's direction has proved of value, there are many reasons why the habitual use of distilled water as a beverage may not be beneficial.

"Many firms with a shrewd eye to business have taken advantage of the 'microbe scare' to place upon the market various forms of distilled water, and have not hesitated to make certain statements, which would be remarkable if true, calculated to attract attention. Certain persons with a sincere idea of benefiting mankind have seen that it was easier to influence ordinary people in regard to articles of drink than in regard to their daily food habits. Thus hundreds of persons will faithfully drink lithia water when they would not submit to a diet which might accomplish the same purpose.

"Similarly the use of distilled water on the table is much simpler than the banishment of certain articles of food or the restriction of an overactive appetite to the needs of an underactive life.

"Water is the universal solvent, and in the human body it carries both food to and waste from the cells and tissues. Water has a selective action in that it dissolves more of some substances than of others, and it drops out one set of salts in the presence of other salts. But, on the other hand, water containing a portion of one salt often dissolves more of another than if it were pure. Water containing common salt dissolves globulin, vitellin, and certain other animal nitrogen substances which are not soluble in pure water, and it is probable that this property has some bearing in the animal economy.

"Distilled water taken on an empty stomach would tend to leach out the cells with which it came in contact, and we know that the life of the cell depends upon the maintenance of its contents at a certain standard. This is a well established fact and not, as one advertisement implies, a vision of a mad microscopist. The testimony of physicians that the prolonged use of distilled water has a tendency to decrease the body weight shows a lessening of nutritive power in the tissues.

"Most persons eat enough salt on their food to bring up the average, and many persons in middle life and after eat too much of all kinds of food and drink too little fluid, so that for them a course of distilled water may be most beneficial, carrying away an excess which would be harmful.

"Since it is true that the same person may accustom himself to the softest waters of the Atlantic coast after having lived for years in the limestone region of the West, where the water contains one hundred times as much mineral matter, and vice versa, it will be seen that habit has much to do with the case. The system soon adjusts itself to the demands made upon it unless it is enfeebled by abuse.

"If an individual over forty is living on potatoes pared before cooking, white bread, unsalted butter, cream, fruit, and sugar, then distilled water would be superfluous if not harmful; but if the diet is rich in meat, in cereals, in milk, and abundant at that, it is very probable that distilled water would remove more of the excess than would a hard water taken as a beverage."

ARTIFICIAL FOODS; WHY THEY EXIST AND WHAT THEY ARE.

By J. PERCY REMINGTON, B.S. (U. of P.)

IN this paper an endeavor will be made to discuss, in a practical manner, the subject of Artificial Foods, touching upon the reasons for their existence, the principles of their use, the composition and manufacture of the various kinds, and the great possibilities which are opened to this comparatively new form of nourishment which is now occupying so much of the attention of the medical men and scientists of the world and the utility of which we are just beginning to realize.

Artificial foods so far have found their greatest use as a substitute for human milk in infant feeding, and although they are sometimes used in diseases of adults, yet, since there are many other forms of diet which can be employed in such cases, they have not found as extensive an application in this field.

It is a well-known fact that among the more cultured classes mothers frequently do not have a sufficient quantity of milk to suckle their young, whereas among the poorer classes, for instance, the peasant women of France and Germany, this statement does not hold true, and it has been this fact that forced us to find some substitute which could take the place of human milk and supply all those ingredients which are necessary for the perfect development of the young.

The belief has been entertained that a paper on this subject would be of interest to the Pennsylvania Pharmaceutical Association at this time, because pharmacists are probably more frequently consulted by parents than even physicians, and the future welfare of our race, in a measure, depends upon the raising of the children. This, therefore, becomes a subject upon which none can afford to be ignorant.

Although much has been written upon this subject by authorities all over the world, no one has so far undertaken to collect this scattered knowledge into one book, so that, in order to get a complete understanding of it in its physiological, medical, chemical and commercial aspects, it is necessary to refer to many text-books, journals and even note-books. Nor do the authorities all agree on many of the vital points concerning the best methods of artificial feeding, and the various physiological phenomena which take place in that most fearfully and wonderfully made organism—the human body. In other words, this subject has not yet been reduced to a science.

We can best approach this question by beginning with the general subject of foods for man, touching upon the various kinds, their use, their composition, and the process by which they are converted from their crude state into forms serviceable for the maintenance of life.

Food is that "which is eaten for nourishment." Man's food consists of animal, vegetable and mineral matters, and must supply a sufficient amount of proteids, carbohydrates, fats, mineral salts and water to completely repair the waste that is continually taking place and allow the organism to grow.

Various foods supply these elements in different proportions, and are useless or valuable according as they contain more or less of the essentials, and any food which possesses these five substances in proper proportions is capable of perfectly sustaining life, for each supplies the necessary material for the development of tissues, nerves, glands, juices, fat, bones, ligaments, etc., and for the maintenance of the bodily temperature, and the production of energy.

The proteids or albuminoids contain nitrogen and supply the elements for the foundation and repair of the tissues, brain, muscles, nerves, glands, blood corpuscles, and the resisting power against disease. Protoplasm, the center of cell life, is formed of and nourished by proteids. They are, therefore, the most important elements in our food, and are the only ones, when used alone, that are capable of sustaining life.

They may be of animal or vegetable origin, such as egg, meat, milk and the gluten of cereals.

The fats and oils are second in importance, as they supply by combustion the heat necessary for the body, and without which the activity of the juices, the digestive ferments and many of the chemical reactions

taking place in the body would be destroyed. They also are the main source of our energy, or, to use a crude simile, they are the oils burnt as fuel to keep the engine running. They may be of vegetable or animal origin, as lard, tallow, butter, olive or cotton-seed oil.

The carbohydrates are the next in importance and are employed in the production of fat chiefly, although they also assist the fats in contributing to the production of heat and energy.

They also may be of animal or vegetable origin, although chiefly of the latter, as cane sugar, starch and milk sugar.

The salts supply the chemicals necessary for the formation of bones and the juices, and are derived from both animal and vegetable sources.

Water is the last but not the least in importance, as about 70 per cent. of our body weight is composed of it, and from 75 to 80 ounces per day is needed. It serves for diluting the fluids of the body, for moistening mucous surfaces, as a solvent for food and a distributer and regulator of heat, and enters into all chemical reactions that take place in the body.

There are very few foods which can be directly utilized by the human economy without first undergoing a process of physical and chemical change or digestion.

This process takes place in various stages in the alimentary canal. In the mouth the food is mechanically subdivided, ground up and masticated: in the stomach it is thoroughly mixed with the digestive juices and allowed to pass a little at a time into the intestines, where the valuable material is extracted and absorbed. In other words, in this great factory the mouth is the mill room, the stomach the laboratory, and the intestines the shipping department where the products are carefully selected, classified and distributed throughout the various parts of the body.

As the use of proper food is the source of our life and health, so the use of improper food may be the cause of disease, and in such cases, the best cure is the removal of the cause by the substitution of proper feeding. Hence we see food acting in the double capacity of a means of nourishment and a medicine. It must not be confounded with medicine, however, which is a remedy for disease, but it is very convenient when we can, by selecting a proper food, promote life and cure disease at the same time.

A very large proportion of the diseases of children results from some form of insufficient or improper feeding, and as very often the evil effects then produced are carried on to maturity and show themselves in dyspepsia, indigestion, deformities, etc., the question of dietetics assumes a very serious aspect. It is for this reason that artificial foods have been received with so much favor by physicians, and the subject has received such careful consideration. It is very fortunate that so much is being said and done in this direction, for a practical knowledge of the feeding of infants and of the sick is of the most vital importance to mothers, nurses and the general public, and it is just as necessary to know what to avoid as what to eat.

Having taken up the question of foods in general, their composition, the importance, specific uses and the relative value of the five ingredients, proteids, fats, carbohydrates, minerals and water, let us consider the various forms of artificial foods on the market, remembering that they are valuable only as they supply the above essentials in the requisite proportions, in a form physiologically capable of digestion and sufficiently palatable to be eaten.

The first substitute that is naturally employed for this purpose, because of its similarity to human milk, and its accessibility, is cow's milk. For adults it can be used fresh and without dilution, and is employed very extensively in this way, but for infants it is generally diluted by the addition of two parts of water to one of milk.

Theoretically this is the best and most serviceable substitute that can be used, and for this reason milk laboratories have been established in the large cities of this country for the purpose of furnishing pure sterilized, modified milk of any desired proportion of casein, cream and lactose. The milk of goats, asses, and mares has been employed as a substitute with some success, but owing to practical difficulties can never have any very extensive use. Cow's milk, no matter how carefully modified and prepared, cannot be taken by all children, largely on account of the following facts: The casein is present in a much greater proportion than in mother's milk, is not nearly as digestible, as it coagulates in heavy masses instead of the fine flocculent curd of human milk. It is deficient in milk sugar, contains many bacteria, including some pathogenic varieties, is acid in reaction, whereas human milk is persistently alkaline, and is open to the two practical objections that it requires care in keeping and trouble in modification and preparation.

It would be impossible to take up and describe each different food upon the market in detail, and to do justice to all, so for purposes of study it will be most convenient to divide them into general classes.

The points which it will be worth our while to consider can best be taken up under the heads of composition, method of manufacture, and the advantages and disadvantages they seem to possess. It would be well to also bear in mind that the theories upon which the composition of the foods of commerce is based, although necessary to their existence and useful for advertising purposes, are, nevertheless, not to be considered always as based upon fixed, definite and accepted laws, and the best food for a child or an adult is the food that, after many trials, gives the best practical results, no matter what theory it may represent or what may be claimed for it. The old adage, "What is one man's meat is another's poison," is applicable to this condition, and the bare truth, established by practical experience, remains, that there is no artificial food which will infallibly suit every case.

Manufactured foods may be conveniently divided into the following classes: Predigested foods, milk foods, cereals, and complete foods.

By milk foods we mean those which are prepared from cow's milk, the chief representative of which is condensed milk. It is prepared by slowly evaporating off the water at a moderate heat in vacuo till the milk has assumed a sirupy consistence. There are many brands of condensed milk on the market, and may be of two varieties. The "plain," which is condensed to about one-fourth its bulk, with the addition of a small amount of cane sugar, and the "stronger," in which the condensation is carried further, and a much larger quantity of cane sugar is added, sometimes running as high as 70 per cent.

This makes a very cheap food and is easily prepared, requiring only dilution, and is quite palatable, and hence is used largely among the poorer classes. It is somewhat laxative in its effect, which is an advantage quickly realized by the nurse. Condensed milk, however, is not a satisfactory food for permanent use. Children fed on it thrive very well for a time and rapidly gain in weight, but the flesh formed is flabby, with a large amount of fat, and it has a tendency in time to produce rickets, marasmus, and general symptoms of malnutrition.

Another form of milk food is that which is prepared by predigestion by some ferment, such as pepsin or pancreatin. There are very few foods of this kind on the market, as their field is very limited. They find their best use as a temporary expedient after surgical operations or where the alimentary tract is so impaired that digestion becomes impossible, and it is necessary to give some food which can be directly absorbed without any effort on the part of the invalid.

When, however, they are employed for permanent nourishment, they are detrimental and demoralizing, for they encourage the digestive functions to become lazy and finally rob these organs of their ability to obey the commands of nature. Thus we impair instead of developing and strengthening vital parts of the body.

There are also condensed creams and peptonized condensed milks on the market which combine the features of the two above classes, but are not very important.

Among the other foods of animal origin, although of more recent application, are those prepared from beef.

Of the many beef juices on the market it will suffice to remark that they furnish very concentrated nourishment, since most of the indigestible fiber, muscle sheaths, blood vessels, etc., are removed in the process of manufacture, and water is driven off by evaporation. They have quite an extensive use, but mostly for adults, being very seldom used for children except as an addition to milk or other food.

Eggs offer a remarkably efficient form of nourishment, as they contain proteids and fat in a concentrated and assimilable form, are easily procured and prepared and quite palatable.

Fresh eggs have always been a very popular food for both adults and infants as an addition to milk and other kinds of diet.

During the last few years attention has been called to the value of eggs as a substitute for the indigestible casein in milk foods, on the grounds of their digestibility and nutritive value. There are three strong points in favor of the egg as an ingredient of artificial food.

1. That when it is desiccated and finely powdered it is effectively preserved against decomposition.

2. It forms very fine and flocculent masses on coagulation, and hence gives the greatest freedom to the digestive juices to act upon it; and

3. That it exerts an active influence upon the mucous membrane of the stomach, allaying irritation and soothing inflamed surfaces.

The greater number of artificial foods belong to that class in which cereals are used as the basis.

These prepared farinaceous infant foods are made by the following methods:

1. Application of heat alone.

2. Digestion with malt or diastase combined with heat.

3. Addition of animal matter to cereals after dextrinization.

The first class comprises all those foods made with cereals alone and intended to be used as modifiers of cow's milk.

Wheat, barley and oats are the grains used in their manufacture, and the starch present, often amounting to 75 per cent., is partly dextrinized by the cooking, cellulose and indigestible matter being more or less completely removed in the process. All that can be claimed for these foods is that they are a useful addition to cow's milk for adults and older children, but contain too large a percentage of starch to be of value for young children, as very few infants develop the ability to digest starch till the sixth month.

In justice, it must be said, however, that practical experience seems to show that a small percentage of starch is not only often digested by infants, but has a very beneficial, mechanical effect in increasing the peristaltic action, exerting a laxative tendency and aiding digestion.

The second class, the malted foods, had their origin in the theories and are the result of the experiments of Liebig, and for that reason are often called "Liebig Foods."

They are made of equal quantities of wheat flour and barley malt with a little bran and about one per cent. of potassium bicarbonate added. These ingredients are mixed with water into a paste and allowed to undergo fermentation, which converts the starch into soluble carbohydrates, maltose, and dextrin. The mass is then strained, pressed, extracted with water and evaporated, dried and powdered. In some of these foods a small percentage of starch still remains. The general characteristics of these foods are complete solubility, a strong and sweet taste, agreeable to most people, but which may, by constant use, become nauseating. They are easily assimilable, require little digestion, and are quickly prepared. They are not complete foods, however, as they contain little or no fat and no animal proteid, although there is albuminous matter present in the form of gluten. They are, therefore, not to be used alone, but, like the first class, should be prepared with milk.

In the third class of foods an attempt is made to supply both vegetable and animal matter, or, in other words, to make a complete food; they are of the more recent manufacture and are the result of the practical experience of the manufacturers of the previous class of foods.

This class does not comprise a large number of products, but has met with greater favor and is certainly a step in the right direction.

They are of three kinds:

1. Such as are composed of an extract of barley and wheat, to which powdered, dried, and predigested milk is added.

2. Those composed of dextrinized cereals and unpredigested dried milk.

3. Those composed of dextrinized cereals, sugar of milk, and desiccated powdered egg.

The first kind, that made from predigested milk and an extract of cereals, is similar to the malted foods, having a strong and sweet taste, but is to be taken with hot water only, and hence is easily prepared, and has found a very extensive use, particularly among adults.

It, however, is deficient in fat, containing less than one per cent., and the presence of such a large quantity of sugar is likely to produce fermentation in the stomach and intestines. The effects of these foods are manifested by the rapid production of fat and a gain in weight, and children may even be reared upon them exclusively, but as they possess no antiscorbutic property, they are likely to produce scurvy. Moreover, these foods are open to the same objections that predigested foods are, namely, that their ingredients, being converted into already assimilable forms, do not allow the digestive juices to perform their proper functions.

The second class seems to be open to less objection on this ground, as neither the cereals nor the milk are predigested during their manufacture. In other respects they resemble the preceding closely, except that they require cooking before administration.

The third form, foods made from dextrinized cereals and desiccated egg, rely upon the substitution of egg-albumen for the less easily digestible casein, the dextrinization of the cereals by a double process of cooking (first being boiled and then baked), and are milk foods only in this sense, that sugar of milk alone is present. They possess the following advantages over the others:

They are of a mild, palatable taste, not excessively sweet (as they contain no sucrose or maltose), the casein is replaced by the more digestible egg-albumen and they are not predigested. They are open to these two practical objections, that like the second class they require cooking in their administration and are also deficient in fats. For this reason milk and cream must be added, the milk supplying the antiscorbutic property.

We have now covered all the classes of artificial foods and have discussed their composition and utility in the light of the laws laid down as the result of practical experience by the authorities on this subject, and in conclusion we find that they are all more or less useful, but that they all possess certain definite defects. That no one can tell whether a certain food will be successful in any certain case till it has been tried, and that, as we have said before, the best commercial foods are those which supply the five essentials in the requisite proportions, in a form physiolcgically capable of digestion and sufficiently palatable to be relished. It is clear, then, that since none of these foods meet all of these requirements completely, the problem of artificial feeding has not yet been completely solved.

Yet one cannot glance through any of the best pharmaceutical or medical journals or literature of today without noticing the articles written on this subject by the most noted scientific men, and without realizing that science and art are combining their forces and exerting the greatest activity in the attempt to solve this problem.

Judging from the great interest that this subject has excited, not only among the scientific classes, but with the community at large, resulting in a universal demand for a perfect artificial food, and considering the unlimited resources of this country and its people, the great possibility of supplying this demand, and thus meeting our obligations to humanity, seems almost within our grasp.—American Journal of Pharmacy.

THE EFFECT OF PRESSURE IN THE PRESERVATION OF MILK.

FROM time to time since the fall of 1897, but more especially during the past winter, the chemist of this station has been studying the effect of pressure in the preservation of milk, meats, and fruit juices. Some very encouraging results have been obtained with all these materials. The following is a preliminary report of the work on milk.

Several samples of milk were subjected to pressures of 200,000 pounds to the square inch for a period of one or two minutes, and about fifty samples were subjected to pressures of seventy to ninety tons for five to sixty minutes. In each case, samples ("blanks") of the same milk were sealed up in the same way (in collapsible tubes) and treated in all respects like the samples just mentioned, except that they were not subjected to pressure. No ice was used in any part of this work, and all operations were carried out at the temperature of the room, which during by far the greater part of the time stood at 75° to 80° F. The milk was furnished by a local dairy.

The blanks were always sour in twenty-four hours. All of the samples treated to the pressures named kept twenty-four hours longer than the blanks, some of them forty-eight to sixty hours longer. Two samples that had received ninety tons for one hour remained sweet for more than a week.

Such conclusions as may be safely derived are as follows:

Pressures of over thirty tons per square inch (up to one hundred tons) applied for one hour may generally be relied upon to postpone the souring of milk for twenty-four hours.

Thirty tons for an hour generally delays the souring just about twenty-four hours.

Milk that has been subjected to ninety tons for an hour will generally remain sweet for about four days. And an occasional sample will be found that certainly is not sour even at the end of two weeks, although other changes may have taken place in it.

Very similar results to those just mentioned will generally follow the use of about thirty tons for a period of ten to twelve hours, i. e., they will generally keep sweet for three to five days, and an occasional sample will not be sour at the end of two weeks. From this it would be suspected that in order to obtain similar results with intermediate pressures these should be applied for some intermediate period of time, and to some extent, at least, this appears to be true, although it

should be said that it was pressures of twenty-five to thirty-five tons, and eighty-five to ninety-five tons, that received the most attention.

The best results from a practical standpoint were doubtless those obtained with pressures of ten or fifteen tons for as many days. That milk under a pressure of ten tons could be shipped a five or ten days' journey there can be little doubt, but the cylinders capable of carrying such pressures would probably weigh more than the milk.

A pressure of forty tons and temperature of 126° F. for about an hour was found to have a very marked effect on the keeping qualities of meat, small samples treated in this way being in very good condition when opened three months later. Water that had been placed in the tubes with the meat in order to communicate the pressure uniformly to the meat was highly colored, while the meat was of a light color, but there was no abnormal odor or other evidence of decomposition.—From Bulletin 58, W. Va. Agl. Experiment Sta., Morgantown, by B. W. Hite.

THE GROWTH OF A MIND.

By JAMES WEIR, Jr.

ON the morning of July the 6th I took my chair, pipe and book to a certain wide-spreading beech tree on my lawn. The weather was intensely hot and sultry, and not even the thrilling story of Sven Hedin's escape from the terrible dangers of Takla-makare Desert could keep me from nodding drowsily as I read and pondered on the why and wherefore that led so many men to place their lives in jeopardy, simply in order that one more river, or one more lake, or one more mountain might be added to the geography of the world.

Suddenly my vagrant attention was caught by the sound of a voice, which, to me, was wholly unknown. At first I thought it was a tree-frog, which, as the old nursery rhyme tells us, "would a-wooing go," and which had caught a bad cold during his courtship, so hoarse and so guttural and so "deep down" was the "kroak-kre-a-a-a-k, kro-a-a-a-k kroak" of this unfamiliar cry.

What made this call most peculiar and added to it an element of mystery was the fact that I could not locate it! At one moment it appeared as though it came from the branches above my head; at the next, the sound seemed to come from the grass beneath my feet. After a most diligent search of the trees, shrubs, and bushes in the vicinity had failed to reveal this mysterious stranger, I was returning to my chair when, happening to glance beneath it, the mystery was solved! There, clinging to a small fragment of a broken tree-limb, was the ugliest specimen of young bird-life that was ever created!

At first glance this bird seemed to be made up of three members—bill, abdomen and feet. Its bill was long, thin and slightly curved; its abdomen was large, round and patulous; while the toes of its feet were very long, very pink and very slender. Its eyes were small and vacuous; they had no light of intelligence. Its slender and featherless neck seemed utterly inadequate to the task of supporting its small head and preposterously long bill. This bill was not snipe-like or crane-like in character; it only seemed much too long for the queer little creature.

When the chair was removed and an investigating finger touched this truly bizarre specimen of animal life, the long bill flew open, disclosing a cavernous mouth and throat, from which a harsh, jarring, wiry cry issued, with which the tiny, unfledged, finger-like wings quivered in seeming unison.

For some moments it was impossible to classify and name this singular youngster, for I had never before seen one of his race quite so young and immature; but a close study of his personal characteristics finally declared him to be a rain crow (Coccygus), the American cuckoo.

At the time of first acquaintance, this bird was simply an automaton, a being governed almost wholly, if not entirely, by reflex action and by unreasoning instincts. Here, then, was an opportunity for studying the growth of a mind from unconscious, reflex action to intelligent ratiocinative ideation.

The following history of "Gip's" mental development has been compiled from data which were written down in my note book day by day, as the bird grew older and more able to care for himself.

Being entirely devoid of discriminative knowledge, he would, at first, swallow buds of twigs, small bits of clay, in fact, anything that was placed within his widely yawning mouth. Of course, experiments in this direction were very few for obvious reasons, yet such as were made clearly demonstrated the fact that discriminating taste was not possessed by the little orphan (his mother never made her appearance, hence the inference of orphanage), for, for two days he would eat anything that was given him. At the end of the second day, however, he would regurgitate any unpalatable or indigestible substance, though retaining it for a second or so in his mouth before casting it out.

This fact would indicate that intelligent discrimination and conscious determination, as far as this bird is concerned, begins in the sense of taste.

He was placed, as soon as discovered, in an orange tree tub where he would be out of the reach of stray cats and dogs and where his actions could easily be observed. I presume that he was about one day old when first noticed, hence, he was probably about three days old when his first act of conscious determination was noted. A little perch about three inches high was built and fixed in the earth of the tub about two inches from its edge. On the third day the bird climbed upon the rim of the tub and then jumped to this perch. His conscious intellection may be said to have started on this day. His eyes took on the "knowing look" that one observes in infants when they first begin to observe the outside world, and he was seen to use his bill in getting rid of some of the loose "pinfeathers" which annoyed him. In fact, the ground beneath his perch soon became white with these discarded plumes of infancy.

On this day he refused a large black pismire although he was very hungry when the ant was offered to him; the flavor of the insect was evidently distasteful. It may be stated here that for the first five days the bird was given a mixed diet of insects and beefsteak; after the fifth day nothing was given but the steak. The steak gave him a diarrhœa for a couple of days, but this disappeared, and he grew strong and fat on his meat diet.

This experiment is very interesting, inasmuch as it shows how quickly Nature adapts herself, or, rather, her creatures, to changed environment.

On the fourth day he hopped from his perch to the crotch of the orange tree and essayed to climb its branches. The smooth bark gave him no foothold, however, and his attempts met with failure. I then constructed some artificial branches by tying twigs across from branch to branch, as can be seen in the illustration. "Gip" readily availed himself of this miniature ladder, and on the sixth day he succeeded in mounting to the topmost limbs of the tree.

His plumage grew with exceeding rapidity; in fact, on the fifth day, as can be seen by the photograph, he was quite a respectable looking bird. This picture was made while he was listening intently to the barking of a pointer puppy who was having a battle with a large stag-beetle some 20 feet away from the tub. One can see by the attitude of the bird that he was wholly absorbed in determining the nature of the strange sounds.

On the sixth day he gave me the first evidence of conscious recognition. When I stepped out on the piazza, which is 6 or 8 feet distant from the orange tree, "Gip" greeted me with a cry of recognition and immediately began clamoring for food. He could use his wings to a slight extent, and fluttered from twig to twig toward me as I advanced. The amount of food taken by this bird in twenty-four hours at this time was simply enormous when his size is taken into consideration. He weighed about 3 ounces, yet he would devour at least 2½ ounces of beefsteak during the day.

About this time he began to recognize his name and to answer when I would call "Gip! Gip! Gip!" His answer to this call was low and quite musical. It was not like his first guttural, hoarse "kroak-kro-a-a-k-kroak!" but instead was an open, trilling cry, somewhat like that of the small tree frog (Hyla).

THE AMERICAN CUCKOO.

A striking evidence of his power of observation and recollection was noted on the ninth day. He had never before seen me except when I was in my shirt sleeves, or when I was dressed in a white duck suit; therefore, when on this day I appeared in a black suit, at first he failed to recognize me, but at the repeated call of "Gip! Gip! Gip!" and after he had examined me for some time, he recognized me and answered with his sweet, low, musical trill! This test was the same as though his own mother had been treated to a coat of black paint and then introduced to him.

He would sometimes take food from my little nephew; this he would do, however, only when very hungry. At other times he would turn his head and refuse the offering, no matter how dainty and how appetizing.

On the tenth day he abandoned the orange tree and flew to a cluster of heaven trees (Ailantus) which was densely covered with grape vines. Here was an ideal home for this bird, for the rain crow dearly loves seclusion and is never happier than when hidden from view. It was thought by some of the family that my little protege had abandoned me forever, but I thought differently. I had more confidence in his affection for me.

The following morning he was called at half past four o'clock, and at the third call of "Gip! Gip! Gip!" he flew from the ailantus tree into the orange tree, when he immediately began to demand breakfast in no uncertain terms. What is more wonderful, as soon as he had been fed, instead of secreting himself among the leaves he snuggled (if I may use the word) against my neck, and caressed the lobe of one of my ears with soft nibblings; just as I have seen young chicks peck the necks of their mothers.

On July 22, he was placed in one of the pockets of my coat, and carried to town in order that a friend, who had never seen a rain crow, might become acquainted with him. When first placed in the pocket he was very uneasy, and tried to escape, but when I put my hand therein, he immediately mounted upon one of my fingers and became quiet. When he was taken out of the pocket in the office of my friend he did not attempt to fly, but remained perched upon my finger, closely observing the unfamiliar surroundings, and uttering all the while short, querulous cries.

As has been stated elsewhere in this paper, the rain crow is exceedingly shy and always selects the densest shades of the forest for its abiding place. This trait is clearly shown by my little pet. Whenever I go into my rose garden, which lies next to my lawn, and in which there are no trees, "Gip" will accompany me as far as the last tree, a Seckel pear, where he will remain and scold until I return.

He soon discovered my room, and will sit in a service berry tree opposite my window for hours at a time. As soon as he sees me leaving my desk, he will fly to a pine tree in front of the house and will wait until I come out.

The exceeding tameness of this most interesting bird is quite remarkable, especially when its natural habits are taken into consideration. Coccygus is essentially a wild bird, and, though it may be seen occasionally near the habitations of man, it usually selects unfrequented and remote places for its home. I have never seen nor have I ever before heard of a tame rain crow. I therefore think that "Gip" is unique.

He affords an interesting study of the gradual, though in a sense exceedingly rapid, development and growth of mind. From a mere automaton, as it were, governed and directed by unconscious reflex action or instinct, he, day by day, gained in mentality, until finally almost every action seems to be the result of conscious determination and intelligent ideation. His memory of persons, his evident affection and love for the individual who has acted in loco parentis, his shrewdness in discovering the place at which this individual is most frequently to be found, and his ready adoption of habits so utterly foreign to his natural state, indicate a high degree of mental acuteness.

Recently he has begun to follow me about the place, flying from tree to tree, or perched upon my head or shoulders. Yesterday (July 22), contrary to my usual custom, I walked into town instead of taking the street cars, and "Gip" accompanied me for quite a distance along the road. When I returned, he saw me and flew to meet me with many a low call of recognition. He has never been confined in a cage or room, but has lived in absolute freedom all his life. He has become quite a local celebrity and has many visitors. It must be confessed, however, that he treats them with scant ceremony, and lavishes all his attentions on his foster parent. He is still with me at the time of this writing, (July 23), and from all appearances will remain until the frosts of autumn warn him that winter is coming, and that it is time for him to seek a more genial clime.

A NEW WATER COLOR MEDIUM OR VEHICLE.

By RUFUS F. HERRICK.

IN 1883 the writer, who had some acquaintance with the vehicles used in oil color painting, decided to investigate the possibility of finding a vehicle for use in water color painting.

It was decided to subject samples of various drying oils to the action of sulphuric acid, and the endeavor was made to produce a finished article from each of these oils, and have them properly tested as vehicles by some professional water color artist. Linseed oil was chosen as the prime source, and the next two most important drying oils, walnut and poppy oils, were also investigated in this connection.

Linseed oil was first treated with sulphuric acid. It turned black, gave off some odor of sulphurous acid, and became of a stringy, rubber-like consistency. The mass so obtained was manipulated with some difficulty, but gave a fair-looking product. Various proportions of sulphuric acid were tried upon the oil, until it gave a product containing the minimum quantity of free oil when finished. Various temperatures were also tried, and the length of time was varied during which the oil was left in contact with the sulphuric acid.

The "raw" as well as the "boiled" linseed oil appeared to possess the same disadvantages during manipulation as mentioned above. Wishing to overcome this objection, it was decided to experiment with "linoleic acid" as made from boiled linseed oil, and this gave the best results. Some linoleic acid was therefore obtained from boiled linseed oil by the method given in Amelin's works, published by the Cavendish Society.

When this linoleic acid was subjected to the action of sulphuric acid, the mass turned blackish in color as before, but did not grow stringy and rubber-like as with linseed oil. The solution of its finished product in water separated into two layers—the upper one clear, the lower one turbid. This upper layer formed a clear solution in water; the lower layer formed a milky-looking emulsion. The clear solution from the upper layer was superior to that from linseed oil, and kept better.

Trials were then made on walnut and poppy oils, both of these being valued in oil color painting. The product made by the action of sulphuric acid on poppy oil was unsatisfactory. After standing about four months it separated into three distinct layers. The upper one was of an oily nature and brownish in color, with middle layer grayish and watery in character, while the third and lower one was whitish in appearance and somewhat thick, resembling thin flour paste. The upper layer being clear, it was examined for its physical properties. It would not dissolve clear in water, but merely gave a milky emulsion. For these reasons poppy oil was not further experimented on. Walnut oil, by the action of sulphuric acid upon it, gave a product that continued to deposit a considerable whitish sediment on standing. The upper portion of the product was clear, and gave good results when used as a medium in water color painting, but its keeping qualities were poor.

Mr. Henry W. Herrick, an artist of some fifty years' experience, who so far had himself discouraged the use of any medium or vehicle, was so thoroughly convinced, after some two years' experimenting, of the great merits of the medium made from linoleic acid, that he has ever since used it in all his water color work. He prefers the product as obtained from boiled linseed oil.

Mr. Louis Prang, after several years' use of this water color medium, as made from boiled linseed oil,

considers it superior to ox gall, and he has strongly recommended its use.

It makes all colors flow much more evenly and smoothly, this being especially noticeable in the heavier colors, which usually wash on in a very uneven manner. Washes may be overlaid without disturbing the under-color, and greater brilliancy is imparted to all the colors. It dries to some extent like a varnish, and thus protects colors against dampness, foul air, or gases. It fastens colors better and works as well upon papers of coarse texture as upon a smooth surface, as well upon Whatman's as upon Harding's. Excellent results attend the washing over of the paper with the medium before beginning a picture, thus removing any danger of the paper being greasy, and so repelling color washes unevenly. It is stable in character, keeps well, appearing to work as well and remain as clear after the lapse of several years as when freshly made.

It is not used in body color in the same way that oil colors are mixed with oil upon the palette, but the best results are obtained by painting in the usual manner, the only change being that one stirs a few drops into the water from which the washes are made.

For distant effects the quantity of medium used is less than for foreground effects. In the latter case, in rare instances, it can be used directly as body color in "loaded" touches. No objectionable features seem indicated by its use. This article is not to be used as a varnish after the picture is finished.*—The Journal of the Society of Chemical Industry.

SOME DRAWING OFFICE METHODS.

IN a paper on drawing office methods, in The Journal of the Worcester Polytechnic Institute for March, by Mr. Charles F. Bailey, some valuable suggestions on the management of the drawing office were brought out. While the methods given in this paper can be best applied to large drawing offices, it would be well to consider them even in organizing a smaller one. The author's idea is that where there is a large amount of work in the drawing office, there should be a careful sub-division of the work and one man placed in charge of one or more sub-divisions, so that whether the chief draughtsman is present or not, the whole work will go on uninterruptedly. Where there is work of a complex nature, the principal points are carefully thought out and settled by the chief before giving it to the leading man. Where this method is carried out it may be found desirable to establish an estimating or scientific department, where all preliminary estimates and designs are prepared. A copy of the calculations, which are filled out on blank form, and the designs as worked out by the estimating department, are given to the leading men in the drawing room who have charge of the jobs. In this way the engineer or chief draughtsman is enabled to go over all calculations and carefully check them, as he can readily do this with the aid of the slide rule. Often sketches are inserted in the notes which are passed on by the chief.

The author states it has been found to facilitate the work of the office to hold a consultation each morning with the leading men and plan the work for each man in the office. In this way each draughtsman is loaded with work, and he consequently feels a much greater incentive to do his best than when kept in ignorance of what his next job will be. When the men are left to take their time in making drawings, it is usually the case that much more time than is necessary will be consumed on drawings. It is a great advantage to require from time to time from each leading man a list of all work that remains unfinished on each job under his charge; in this way the important work can be gotten out first. The office should be provided with a set of standard tables, giving the dimensions of all standard work, such as bolts, nuts, key seats, various kinds of fittings, etc. It is necessary to keep close watch on all drawings as they are being developed at the boards, and make any alteration that appears necessary.

When a drawing is completed, a print is taken on cheap paper for examination. The man who has the job in charge checks the drawing from this print, making all alterations in red, and checking all correct figures and dimensions with a yellow pencil. When drawings are completed, they are taken to the chief draughtsman, and after receiving his signature are sent to the shop.

The author states that the work may be subdivided on each drawing, thus: Pattern work and castings are shown on one drawing, coppersmith work on still another, etc. Another drawing or general arrangement shows the machinery as erected. The practice of using bond paper for drawing has been abandoned for the use of a good quality of tracing linen, which is much more satisfactory for several reasons. It is thought cheaper, and wears and prints better than the bond paper. All drawings are indexed in a running index book, in which the numbers are arranged consecutively. After this they are indexed in a card index and then filed. All blue prints that are sent to the shops are indexed on blue cards and placed in a drawer by themselves, in a card index cabinet. Whenever a draughtsman obtains a drawing, a slip is made out charging him with the drawing. This is returned to him or destroyed on the return of the drawing.

The temperature of the Bunsen flame has recently been measured, and found to be above 1,820° C. According to The American Electrician, M. Beikenbusch, who conducted the test, employed a thermo-couple, heating it by an electric current until it had the same temperature as that of the flame, so as to eliminate errors due to radiation and convection; the temperature of the thermo-couple for that same current is then measured in a vacuum. The general idea of making the two temperatures equal, and then measuring one of them by a more convenient method than measuring the original one directly, is a good one and may be applied in other cases to advantage.

* The works of Allen, Lewkowitsch, Knecht, Rawson, and Loewenthal discuss the action of sulphuric acid upon several oils, and under varying conditions. The resulting products are also described. In the absence of any published work in regard to the action of sulphuric acid upon linseed oil or its principal constituent linoleic acid, the field of conjecture is open as to the chemical composition of the resulting products made as described in this article. Indeed, it may be argued that possibly they do not possess a definite chemical composition or formula at all. It is hoped at some future time to investigate this question.

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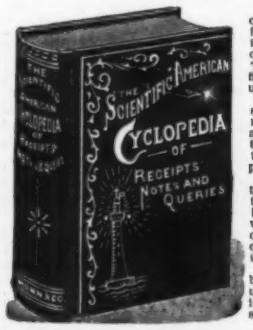

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